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THE HEALTH THEME IN FAMILY PLANNING

ABDEL R. OMRAN

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ABDEL R. OMRAN

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THE AUTHOR

Dr. Abdel Omran is Professor of Epidemiology in the School of Public Health at the University of North Carolina, and Associate Director for Population Epidemiology of the Carolina Population Center. He holds the M.D. degree from Cairo University and the Dr.P.H. from Columbia University School of Public Health. At present he is serving as coordinator for a World Health Organization international collaborative study on the relation of family size and health as well as on the relationship of childhood mortality and reproductive patterns.

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INTRODUCTION

THE HEALTH THEME IN FAMILY PLANNING

Until recently, public health has been generally, but unfortunately, narrowly conceived of as the instrument of "death control"; this has resulted from an overemphasis on the death-controlling potential of public health measures, particularly in developing countries. It is now essential that medical and public health workers, as well as social scientists, broaden their thinking to include improvement of the quality of life of the people whose lives are preserved through public health measures; it is essential that more consideration be given to the harnessing of public health techniques for the promotion of good health and human development, and for birth control as well as for death control.

Another extremely important basis for the interest in the health benefits of family planning is the need to enrich the motivational system for family planning at the family and individual levels. To interest couples in their own health and the health and development of their children would, it seems to me, increase the acceptance of family planning, especially in areas where the masses of people are not oriented toward the demographic and economic consequences of excessive fertility for their countries as a whole.

This monograph focuses on two basic premises: The first is that there are potential direct health benefits to be derived from family planning for all family members, especially mothers and children. The second is that there are possible ramifications of health improvements, especially when manifested in improved childhood survival, on the acceptance of family planning and subsequent reductions in fertility.

In order to support the first premise — that family planning can be a favorable influence on the physical, mental, and intellectual development and well-being of family members — it is necessary to examine carefully the undesirable conditions that may be severely aggravated by too many, too frequent, and poorly timed births (or abortions). In this monograph, I will examine briefly the recent literature on the many and complex relations between a set of family planning variables which includes family size, birth order, birth interval, and maternal age, and a set of dependent variables which includes perinatal and childhood mortality, maternal morbidity and mortality, physical, mental, and emotional health of family members, and physical and intellectual growth and development of children. A third set of variables that may affect the association between family planning variables and family health and well-being encompasses a host of environmental and socioeconomic variables which are not dealt with in detail in this monograph, but the influence of which must be duly noted, and which are, in the best of the studies reported here, controlled for.

It must be emphasized that attempts to study the association between these sets of variables are complicated by their myriad potential combinations. The evidence on the influence of any one factor in producing any given consequence — high parity producing high perinatal mortality, for example — is often equivocal; however, important trends in such one-to-one relationships are apparent, and there is persuasive evidence on such one-to-one associations from studies in which other potentially influential variables have been controlled for. Furthermore, there is little doubt that certain combinations of factors greatly increase the risk of certain results; for example, very young, poor mothers of high parity, having closely spaced pregnancies, run a much greater risk of stillbirth or of having their infants die early in life and of themselves suffering ill consequences of the pregnancy than are mothers who are of higher socioeconomic status, who are having a second or third child after a reasonable interval since the last one.

In regard to the second premise — that improved childhood survival may contribute to acceptance of family planning — I will investigate historical, theoretical, and empirical evidence which shows that fertility declines seem generally to follow declines in childhood mortality. Contemporary evidence shows that parents whose experience in their own families and communities has taught them to compensate in advance for expected childhood deaths are likely to accept family planning only when they perceive an improvement in childhood survival and can be confident that the children they have will survive.

In conclusion, it will be possible to draw upon the evidence presented in the body of this monograph to support conceptual, professional, and cultural rationales for the health theme as a central and persuasive part of family planning programs.

1

THE HEALTH THEME IN HISTORICAL PERSPECTIVE

Men and women have sought and used means to prevent conception since the time of ancient civilizations; a few of the ancient contraceptive techniques were effective, but more were magical, and knowledge of them was transmitted by word of mouth. It was not until the time of industrialization in western Europe that birth control was advocated publicly and that a movement began to gain momentum with increasingly widespread use of contraceptive devices and techniques no longer magical but progressively more scientific and sophisticated. Since the turn of the nineteenth century a number of themes have been promulgated to explain the need for and to encourage the general use of the available methods of birth control. Each of these themes emphasizes a different facet of human activities and aspirations, but all have supported the same conclusions: that families should be planned and that excessive fertility should be curbed.

The major birth control themes can be identified as the ecologic, social, family health, eugenic, feminist, and nationalistic, and they are presented here in the order in which they have been introduced into the birth control movement. These themes are represented schematically in Figure 1. Special emphasis is given to health as a particularly important element in the combination of all these themes to support effective family planning. It is unfortunate that public health professionals have only recently become seriously involved in family planning, despite the fact that the development of modern public health practices antedated the modern birth control movement. This delay can be attributed largely to the generally accepted but disappointingly narrow conception of public health as "death control," which results from an overemphasis on the death controlling potential of public health practices, especially in developing countries. In consequence, public health has been seen as a force

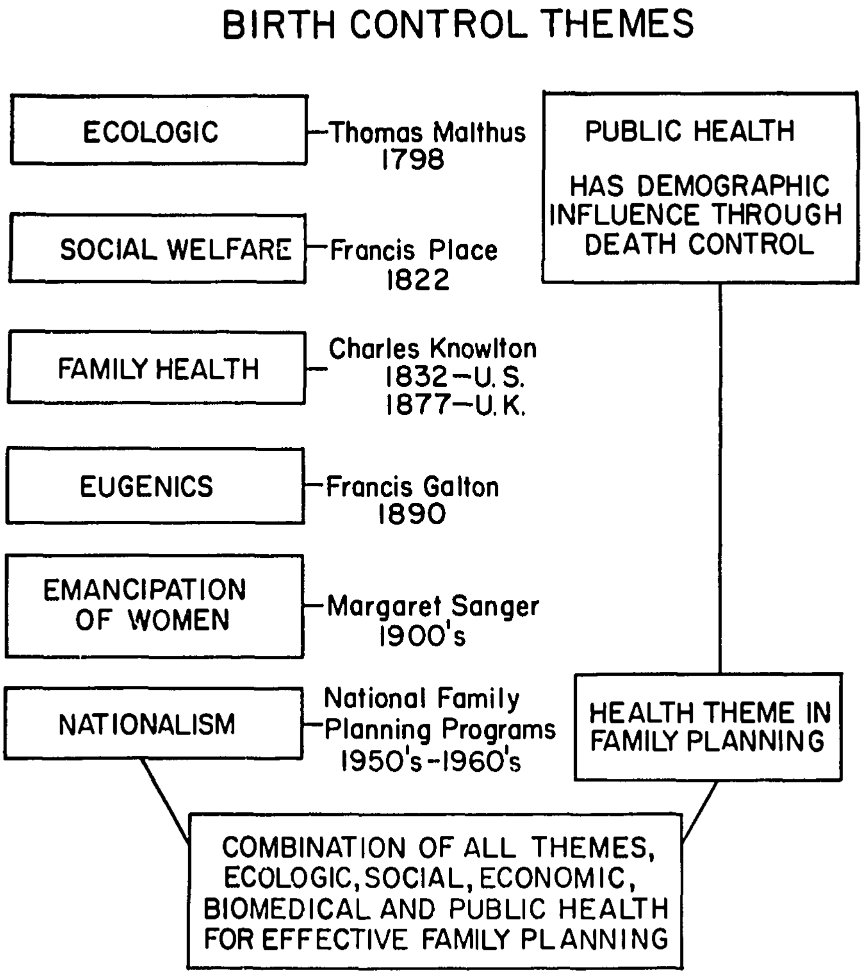
BIRTH CONTROL THEMES
ECOLOGIC
Thomas Malthus 1798
SOCIAL WELFARE
Francis Place 1822
FAMILY HEALTH
Charles Knowlton 1832—U.S. 1877—U.K.
EUGENICS
Francis Galton 1890
EMANCIPATION OF WOMEN
Margaret Sanger 1900's
NATIONALISM
National Family Planning Programs 1950's-1960's
PUBLIC HEALTH
HAS DEMOGRAPHIC INFLUENCE THROUGH DEATH CONTROL
HEALTH THEME IN FAMILY PLANNING
COMBINATION OF ALL THEMES, ECOLOGIC, SOCIAL, ECONOMIC, BIOMEDICAL AND PUBLIC HEALTH FOR EFFECTIVE FAMILY PLANNING

Figure 1. The chart shows the first major proponents of each of the birth control themes discussed here, and the hoped-for combination of all these themes to give effective support for family planning programs.

for population growth, and some economists and others concerned with public planning hesitate to strengthen health programs in population pressure areas. Heretofore, insufficient consideration has been given to the fertility depressing potential of health betterment and to the harnessing of public health techniques in the promotion of birth control as well as death control.

Although no one person can be given full credit for the development and advocacy of any of the themes outlined below, in most cases some individual stands out from the rest as having drawn together the thoughts of others as well as his own and propounded them or acted upon them in such a way as to give them significant visibility and impact for the first time. This was certainly true of Thomas Malthus, the most famous of population theorists, and of Francis Place, the first activist of the modern birth control movement. To treat each of these themes separately is not to suggest that later themes have not drawn upon earlier ones, for they have—extensively; it is merely to suggest that new force has been given to the support for birth control by some distinct additional argument.

ECOLOGIC THEME

The ecologic theme in population theory suggests that human population, if unchecked, will outstrip the capacity of the environment to contain and sustain it. This theme sparked contemporary debate about the effects of population growth when first presented in a comprehensive manner by Thomas Robert Malthus (1766-1834) nearly two hundred years ago, and it has been at least acknowledged by virtually every author who has written on the subject of population growth since then.

Malthus, an English preacher-economist, published the first of several editions of his *Essay on the Principle of Population* in 1798; then for five years he read widely in philosophy and economics and traveled on the continent to gather demographic data before he issued an expanded and revised edition of the *Essay* in 1803; only minor changes were made between this second edition and the subsequent five, the last of which was published in 1872.

The basic postulates remained virtually the same in the first and later editions of the *Essay:*

> Population, when unchecked, increases in a geometrical ratio. Subsistence increases only in an arithmetical ratio. A slight acquaintance with numbers will shew the immensity of the first power in comparison of the second.[1]
>
> . . . the increase of population is necessarily limited by the means of subsistence. . . . population does invariably increase when the means of subsistence increase.[2]

At first Malthus saw no escape from the consequences of population growth, believing population could only be "kept equal to the means of subsistence by misery and vice."[3] In the second and successive editions of his *Essay* he gave some detail on the "positive checks" to population growth, namely the miseries of famine, epidemics, and war; however, he also held out some hope to the prudent, thoughtful person who would see the merit in practicing "moral restraint," the least painful of the checks on population growth that Malthus saw as ethically permissible and practical. By "moral restraint," which he also called the "preventive check," Malthus meant nothing more nor less than late marriage, with the interval between the ages of puberty and marriage being "passed in strict chastity." Because of his ethical and religious beliefs, Malthus regarded contraceptive practices as "improper arts" not to be used under any circumstances, and it is therefore ironic that early birth control advocates were often called "Malthusian."

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[1] Thomas R. Malthus, *On Population* (New York: The Modern Library, 1960; first published in 1798), p. 9, cf. pp. 154 and 156.

[2] *Ibid.*, p. 52, cf. p. 165.

[3] *Ibid.*

Setting aside Mathus' abhorrence of birth control measures other than "moral restraint," his ecologic argument that human population would overwhelm the environment is gaining new force today through concern over the quality of the natural environment and the depletion of natural resources.

SOCIAL WELFARE THEME

Francis Place (1771-1854) was the first activist of the birth control movement and the first also to promote birth control as a social welfare measure, carefully outlining its social and economic benefits for the poor.

Place grew up in a poor family, was apprenticed at an early age to a breeches-maker, and worked at that trade and as a tailor to wealthy customers until he had achieved his aim of being financially secure enough to retire from business and devote himself to political and social concerns. Place's lifelong interest was focused on the promotion of the welfare of working people, for he and his wife had suffered considerably as a result of his having led strikes for better working conditions. After his retirement at the age of 46, Place engaged in such projects as the repeal of the Combination Laws (which prohibited workers from organizing to win better working conditions), support of the Reform Bill of 1831-32, and advocacy of schools for working class children.[4]

It was within this framework of concern that Place fostered birth control education. In 1822 he published *Illustrations and Proofs of the Principle of Population*, an explication of the debate on population between Malthus and Godwin. As a result of his studies as well as his own experience (Place fathered fifteen children, five of whom died in childhood), Place became convinced that more effective means of birth control than malthusian "moral restraint" were essential to the advancement of workers' welfare. He went beyond pointing out the need for birth control information; he sought to provide it to the people who needed it most by publishing two handbills and a pamphlet in 1823: "To the Married of Both Sexes," "To the Married of Both Sexes in Genteel Life," and "To the Married of Both Sexes of the Working People."

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[4] Peter Fryer, *The Birth Controllers* (New York: Stein and Day, 1966), pp. 43-57.

The pamphlet addressed to "the working people" not only detailed the means of preventing conception in simple, direct language, but also discussed the economic and social justifications for birth control. Place argued that when there are too many workers, "wages are reduced very low, and the working people become little better than slaves."[5] Thus, to keep their numbers to such a level that their labor is in demand and they can command decent wages and working conditions, workers should limit the number of their children. Further, Place pointed out that when wages are low and children many, families cannot maintain themselves except by the social evil of sending children to work, and "the misery of these poor children cannot be described, and need not be described to you, who witness them and deplore them every day of your lives."[6]

The direct effects of Place's campaign cannot be measured, but he did influence other social thinkers of the day; he began to delineate the social and economic desirability of birth control and began the process of public education on birth control.

FAMILY HEALTH THEME

The argument that a woman's health is undermined by many and frequent pregnancies has often been invoked in support of birth control programs; the proposition that the health of other members of a family may likewise be endangered is investigated in detail in this monograph, and may lend additional and persuasive support to family planning programs.

One of the first people to suggest a health basis for the use of birth control was Charles Knowlton (1800-1850), a Massachusetts physician who was also one of the very few physicians to be involved in providing birth control information in the United States until nearly a century later.

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[5] Francis Place, "To the Married of Both Sexes of the Working People" (1823), reproduced in Norman E. Himes, *Medical History of Contraception* (New York: Gamut Press, 1963), pp. 216-17.

[6] *Ibid.*

In 1832 Knowlton published a small book called *Fruits of Philosophy or the Private Companion of Young Married People,* the "first reasonably full account" on birth control published in the United States.[7] As a physician, Knowlton did not believe that "vice, war, pestilence, and famine" should be allowed as the means of avoiding overpopulation. And he was able to add another dimension to the ecologic argument by introducing the concept that family health, regardless of population pressure, is greatly affected by the level of fertility in the family. His position was that in order to maintain the health of mother, father, and children, fertility had to be reduced through birth control. In *Fruits of Philosophy,* he argued his case thus:

> How often is the health of the mother, giving birth every year to an infant—happy if it be not twins—and compelled to toil on, even at those times, when nature imperiously calls for some relief from daily drudgery. How often is the mother's comfort, health, nay, even her life, thus sacrificed! Or, if care and toil have weighed down the spirit and at last broken the health of the father, how often is the widow left, unable, with the most virtuous intentions, to save her fatherless offspring from becoming degraded objects of charity, or profligate votaries of vice![8]

Knowlton also felt that temperate gratification of the "reproductive instinct" was virtually essential to good health:

> I admit that human beings might be so constituted that if they had no reproductive instinct to gratify, they might enjoy good health; but being constituted as they are, this instinct cannot be mortified with impunity. It is a fact universally admitted, that unmarried females do not enjoy so much good health, and attain to so great an age as the married. . . .[9]

So strong was Knowlton's belief in birth control that he considered it to be within the ethical responsibility of family medical practice. As he put it,

> it is as much the duty of the physician to inform mankind of the means of preventing the evils that are liable to arise from gratifying the reproductive instinct, as it is to inform them how to keep clear of the gout or the dyspepsia.[10]

After a detailed discussion of reproductive anatomy and physiology, Knowlton introduced what he believed to be an effective method of chemical birth control consisting of syringing the vagina immediately after intercourse with a solution of zinc, alum, pearlash, or any salt that would act chemically on the semen but produce no unfavorable effect on the female.

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[7] Himes, *Medical History of Contraception*, p. 227.

[8] Charles Knowlton, *Fruits of Philosophy: or The Private Companion of Young Married People* (Boston, 1833), pp. 20-21; copy available at Harvard University.

[9] *Ibid.*, pp. 148-49.

[10] *Ibid.*, p. 13.

Like many of the other British and American pioneers in birth control, Knowlton was a freethinker, and in addition to his activities in the furtherance of "the art," as he called birth control, he wrote an unsaleable book, *Elements of Modern Materialism*, and at one time organized free speech clubs in Massachusetts.[11] This concern with free speech was unavoidable for birth control pioneers, for they always had to fight to have contraceptive information published, and many of them were prosecuted for their activities. This was especially true in Knowlton's time in America, when such forthright discussions as his were unheard of; large families were common and certainly such topics as reproduction and birth control were never discussed openly. Consequently, although Knowlton was involved in three different trials and was subjected to a fine and three months in jail, the court action on his book received little publicity. As a matter of fact, the book itself had no dramatic effect in the United States.

In England forty years later, however, attention was focused once more on Knowlton's little book when two leaders of the free thought movement, Charles Bradlaugh and Annie Besant, became actively involved in its defense. They republished it in defiance of police orders, and the notoriety attached to their prosecution and their open discussion of the book in their defense helped focus great attention not only on the book itself but on birth control in general. Newspapers, in reporting the trial, presented to the public for the first time arguments favoring family limitation and discussion of contraception.[12]

There was a noticeable decline in English fertility following the Bradlaugh-Besant trial. Himes felt that since there had been no "appreciable changes in the age composition of the population, in the marriage rate, or in the proportion of women of child-bearing age to the general population," there must have been "a great increase in control over conception."[13] This increase in control over conception can by no means be credited to the trial alone; nevertheless, there can be no doubt that the publicity given to the trial and the successful outcome of the defense in 1879 served to accelerate the spread of family limitation practices in England. The Knowlton book was reprinted and a number of other works on population and contraception were widely circulated, including Annie Besant's *Law of Population* (1879).

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[11] Fryer, *The Birth Controllers*, pp. 99-106.

[12] J. A. Banks and Olive Banks, "The Bradlaugh-Besant Trial and the English Newspapers," *Population Studies 8* (1954): 22-34.

[13] Norman E. Himes, "Charles Knowlton's Revolutionary Influence on the English Birth Rate," *New England Journal of Medicine 199* (1928): 461-65.

EUGENIC THEME

As a theme in the birth control movement, the eugenic has been one of the least felt, for its serious application as a justification for the practice of birth control has actually operated only in cases of severe eugenic indications. Francis Galton (1822-1911), who invented the term "eugenics," defined it as

> a brief word to express the science of improving stock, which is by no means confined to questions of judicious mating, but which, especially in the case of man, takes cognisance of all influences that tend in however remote a degree to give to the more suitable races or strains of blood a better chance of prevailing speedily over the less suitable than they otherwise would have had.[14]

Galton and other eugenicists did not advocate birth control, but in fact feared that it would be practiced only by "the prudent and self-denying," leaving the "impulsive and self-seeking" to out-produce them. However, the eugenic argument — in the form of "negative eugenics" — was adopted by many of the advocates of the birth control movement. Margaret Sanger put it thus:

> The eugenists wanted to shift the birth control emphasis from less children for the poor to more children for the rich. We went back of that and sought first to stop the multiplication of the unfit. This appeared the most important and greatest step towards race betterment.[15]

Since Margaret Sanger made that statement in 1938, advances in genetics have made it possible to calculate genetic risks for individual couples with increasing accuracy. Thus, couples can be advised of the magnitude of risk to their offspring from certain genetic disorders or can be reassured that risks are minimal if that is the case.[16] When serious risks are identified, family planning techniques can be utilized to prevent the birth of potentially defective children.

FEMINIST THEME

Wherever women have begun to move beyond their traditional role as homemakers to participate in social and political activities, they have become more receptive to family planning, often demanding access to contraceptive information and today — at least in the United States — to the right to legal abortions.

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[14] Sir Francis Galton, *Inquiries into Human Faculty and Its Development* (London: J. M. Dent, 1928; first published in 1883), p. 17.

[15] Margaret Sanger, *An Autobiography* (New York: W. W. Norton and Co., 1938), pp. 374-75.

[16] "Human Genetics and Public Health: Second Report of the WHO Expert Committee on Human Genetics," *World Health Organization Technical Report Series,* No. 282 (1964).

The name of Margaret Sanger (1883-1966) is practically synonymous with birth control, for it was she and her adherents who coined the term early in the twentieth century, and it was she who was the most visible of those working to make family planning information and services available in the United States and to join national groups together in the organization that became the International Planned Parenthood Federation.

As a public health nurse in New York City, Mrs. Sanger saw many women undergoing great hardships as a result of too-frequent pregnancies, illegal abortions, and poverty, and with single-minded determination she devoted the greatest part of her life to making birth control information available to all women who wanted it. She published information, gave speeches around the country, and was instrumental in the organization of international conferences; she opened the first birth control clinic in New York in 1916, and was arrested and brought to trial many times before the permanent establishment of the Margaret Sanger Research Bureau, which still operates today. Mrs. Sanger drew on health, eugenic, ecologic, and social arguments to support her position, but her greatest thrust was toward a world of *free* men *and* women, and of wanted, cherished children. She said, "Women can attain freedom only by concrete, definite knowledge of themselves, a knowledge based on biology, physiology and psychology."[17]

NATIONALISTIC THEME

In the late 1950's, many developing nations began to see their high rates of population growth as a hindrance to economic and social progress and hence began to adopt national family planning policies and programs. The United Nations *Report on the World Social Situation* published in 1957 described problems of rapid population growth for developing nations thus:

> Rapid growth of population may complicate the problem of the economic and social development of underdeveloped countries, in three principal ways. First, it can increase the pressure of population on land that is already densely settled and so retard increases in the productivity of agricultural labour. . . . Second, accelerating population growth can aggravate the problem of capital shortage, which is one of the most important obstacles to economic development of nearly all underdeveloped countries. . . . Third, the high birth-rates of the underdeveloped countries create a heavy load of dependent children for the working population. . . .[18]

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[17] Margaret Sanger, *The Pivot of Civilization* (London: Jonathan Cape, 1923), p. 236.

[18] Bureau of Social Affairs, United Nations Secretariat, *Report on the World Social Situation* (New York: United Nations, 1957), p. 24.

Many developing nations have adopted national policies or programs to support or provide voluntary family planning facilities for their citizens. These nationalistically inspired population policies have as their chief aim progress in the social and economic spheres, but they often draw upon one or more of the other birth control themes as well. A few examples from among the many nations which have adopted population policies are given here.

The National Charter of the United Arab Republic gives a straightforward statement of the economic and social goals which motivate the country's family planning program:

> This increase [in population] constitutes the most dangerous obstacle that faces the Egyptian people in their drive towards raising the standard of production in their country in an effective and efficient way.
>
> While the attempts at family planning with the aim of facing the problem of the increasing population, deserve the most sincere efforts supported by modern scientific methods, the need for the most rapid and efficient drive towards the increase of production necessitates that this problem should be taken into consideration in the process of production, regardless of the effects which may result from the experiment of family planning.[19]

Several countries mention the strain on natural resources as a reason for limiting national population; one of these is Barbados:

> The familiar problem of rapid population growth which faces many low-income countries is aggravated in the case of Barbados by the paucity of natural resources and the limited land space available.[20]

Many countries mention the health justification for family planning briefly, including Malaysia:

> Family planning is of vital importance from the point of view of mothers' health and child care and will be implemented in conjunction with the extension of medical facilities and public health.[21]

And Pakistan emphasizes the advancement of women in its official policy statement:

> The spread of literacy and employment opportunities for women, desirable for many reasons, is directly related to the problems of population. Educated women can comprehend the possibilities of family planning more readily; gainfully employed women tend to marry later and to have fewer children.[22]

These national policy statements demonstrate the continued force of all the birth control themes outlined in this chapter and give a good indication of how they can be combined in support of family planning programs, as in Ghana's comprehensive statement:

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[19] Gamal Abdel Nasser, "Draft of the National Charter" (May 21, 1962), in Olivia Schieffelin, ed., *Muslim Attitudes Toward Family Planning* (New York: The Population Council, 1967), p. 24.

[20] "Governmental Policy Statements on Population: An Inventory," *Reports on Population/Family Planning* (New York: The Population Council, February 1970), p. 15.

[21] *Ibid.*, p. 6.

[22] *Ibid.*, p. 7.

> A population policy and programme are viewed as integral parts of efforts toward social and economic development, improvement of health and nutrition, elevation of quality and extension of the scope of education, wider employment opportunities, and better development and use of human resources in the interests of a more abundant life.[23]

Many national leaders have also signed the United Nations' "Statement on Population" which acknowledges population growth as a problem of individual nations and of the world as a whole and affirms the desirability of family planning as a means to enrich human life.[24]

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[23] *Ibid.*, p. 12.

[24] "Statement on Population by World Leaders," first presented at the United Nations (New York) on Human Rights Day in December 1966.

2

FAMILY PLANNING VARIABLES AND PERINATAL AND CHILDHOOD MORTALITY

The family planning variables associated with perinatal and childhood mortality with which we are most concerned here are parity and maternal age. A third important variable, birth interval, will be dealt with in a later chapter. The association between mortality and these family planning variables cannot be completely isolated from other biological influences such as genetic factors, maternal health, and nutrition, or from environmental influences, especially social class insofar as it is a determinant of the quality of family life affecting, for example, housing conditions, nutrition, and medical care utilization.

The studies reviewed here indicate almost uniformly that the risk of stillbirth is relatively high for first births and is lowest for second births; the pattern of increase in risk after the second birth is a matter of some dispute. The evidence available indicates a gradual increase in risk after the third or fourth and a sharp increase after the fifth or sixth birth. Infant mortality, especially in the post-neonatal period, increases steadily with parity, as does early childhood mortality. Many of the studies reviewed here also indicate that health risks are high for children born to very young and very old mothers and that infant and childhood mortality is greater among lower social classes than among higher social classes.[1]

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[1] In addition to the reports summarized in some detail in this chapter, the following presented these results: D. Baird, J. Walker, and A. M. Thomson, "Causes and Prevention of Stillbirths and First Week Deaths: Part III. Classification of Deaths by Clinical Cause: The Effect of Age, Parity and Length of Gestation on Death Rates by Cause," *Journal of Obstetrics and Gynaecology of the British Empire 61* (1954): 433-48; Earl Siegel, Theodore D. Scurletis, James R. Abernathy, and Kathryn B. Surles, "Postneonatal Deaths in North Carolina, 1959-1963," *North Carolina Medical Journal 27* (1966): 366-71; James F. Donnelly, James R. Abernathy, Robert N. Creadick, Charles E. Flowers, Jr., Bernard G. Greenberg, and H. Bradley Wells, "Fetal, Parental, and Environmental Factors Associated with

Since data and studies on perinatal and childhood mortality in less developed nations are limited, it is necessary to draw on studies conducted in industrialized countries for most information on this subject. The applicability of these studies to developing nations might be questioned since, for instance, the infant mortality rate in Great Britain in 1960 was 21.8 per 1,000 live births as compared to 86.5 per 1,000 in the registration areas of India for the same year.[2] Fortunately, a few investigators in developing countries are becoming interested in these issues, and a number of their available reports are considered in this monograph. In addition, western studies generally show some of the same patterns of infant mortality that are shown by the few studies from developing nations, and they do indicate that the relationship of infant mortality and parity is maintained even after the overall infant mortality rate declines.

BRITISH STUDIES OF PERINATAL AND INFANT MORTALITY

It is an interesting sidelight that an association between parity and childhood mortality was reported nearly two centuries ago, when, according to McKeown and Brown, the infant mortality rate in Great Britain "cannot have been less than 200 per 1,000 live births."[3] Table 1, first published by Bland in 1781, gives the number of previous live births and surviving children of 1,389 pregnant women attending the Westminster Dispensary between 1774 and 1781. As indicated in the table, the proportion of children surviving *decreased* with increased family size, and regardless of how high the number of births, the highest mean number of surviving children was 3.38.

Among the most comprehensive studies of the effect on infant mortality of maternal age, parity, and social class[4] carried out in England

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Perinatal Mortality in Mothers Under 20 Years of Age," *American Journal of Obstetrics and Gynecology 80* (1960): 663-71; J. R. Gibson and Thomas McKeown, "Observations on all Births (23,970) in Birmingham, 1947 — VII. Effects of Changing Family Size on Infant Mortality," *British Journal of Social Medicine 6* (1952): 183-87; and S. Leon Israel and J. Deutschberger, "Relation of the Mother's Age to Obstetric Performance," *Obstetrics and Gynecology 24* (1964): 411-17.

[2] *Demographic Yearbook, 1966* (New York: United Nations, 1967).

[3] Thomas McKeown and R. G. Brown, "Medical Evidence Related to English Population Changes in the Eighteenth Century," in D. V. Glass and D. E. C. Eversley, eds., *Population in History* (London: Edward Arnold, Ltd., 1965), p. 298.

[4] The social classes are defined by father's occupation as follows: I, professional; II, intermediate; III, skilled workers; IV, partly skilled workers; and V, unskilled workers.

TABLE 1

Mortality According to Parity from Data for the Westminster General Dispensary, 1774-81

Parity (number of previous children)	Number of women a	Total number of children born b	Total number of children living c	Proportion of children surviving $\frac{c}{b}$	Mean number of children surviving $\frac{c}{a}$
1-2	553	807	430	0.53	0.78
3-4	377	1,300	592	0.46	1.57
5-6	227	1,224	502	0.41	2.21
7-8	130	966	364	0.38	2.80
9-10	55	517	177	0.34	3.22
11-24	47	605	159	0.26	3.38
Total	1,389	5,419	2,224	0.41	1.60

SOURCE: R. Bland, "Some Calculations . . . from the Midwifery Reports of the Westminster General Dispensary," *Transactions of the Royal Society 71* (1781): 366, reproduced in Thomas McKeown and R. G. Brown, "Medical Evidence Related to English Population Changes in the Eighteenth Century," in D. V. Glass and D. E. C. Eversley, eds., *Population in History* (London: Edward Arnold, Ltd., 1965), p. 299; reprinted by permission of Dr. McKeown.

is that by Morris and Heady of the Social Medicine Research Unit.[5] The most important part of their work was the matching of birth and death registrations which made possible an examination of the 80,000 stillbirths and infant deaths that occurred among the one and one-half million births in England and Wales in 1949 and 1950. Morris and Heady were interested in studying the social and biological factors associated with infant mortality, and they gave a succinct statement of the interrelationships between these two types of factors at the beginning of their first report:

> Social factors . . . act through and upon biological factors, affecting the size of family, the spacing of children, the nutrition of mother and child, and the opportunities for infection. In turn, biological factors — the size of family most obviously — profoundly modify the social situation; moreover, as in the complications of pregnancy or the viability of infants born prematurely, they are differently effective in different situations.[6]

In the analysis of the data collected for the 1949-50 births, one of the most important conclusions reached by the Social Medicine Research Unit was this:

> Four factors — the mother's age and parity, her social class, and the region (or part of the country) in which the parents lived — are shown to exert largely "independent" influences on the stillbirth, neonatal, and post-neonatal mortality-rates amongst single, legitimate births in England and Wales in 1949. The word "independent" is used in a defined sense — each factor exerts its own characteristic effect whatever the values of the other factors.[7]

This is not to say that these four factors do not interact with each other; however, it does show, for example, that the effect of increasing infant mortality with increasing parity is maintained even when the other factors are controlled for. The tables and graphs on the following

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[5] All the Morris and Heady articles, which will be referred to hereafter by date and Roman numeral only, were published under the general heading, "Social and Biological Factors in Infant Mortality," with joint authorships and subtitles as indicated below. A useful summary of their work appears in J. N. Morris, *Uses of Epidemiology* (2nd ed.; Baltimore: Williams and Wilkins, 1964), pp. 156-57.

J. N. Morris and J. A. Heady, "I. Objects and Methods," *The Lancet 268* (1955): 343-49.

J. A. Heady, C. Daly, and J. N. Morris, "II. Variation of Mortality with Mother's Age and Parity," *ibid.*, pp. 395-97.

C. Daly, J. A. Heady, and J. N. Morris, "III. The Effect of Mother's Age and Parity on Social-Class Differences in Infant Mortality," *ibid.*, pp. 445-48.

J. A. Heady, C. F. Stevens, C. Daly, and J. N. Morris, "IV. The Independent Effects of Social Class, Region, the Mother's Age and Her Parity," *ibid.*, pp. 499-503.

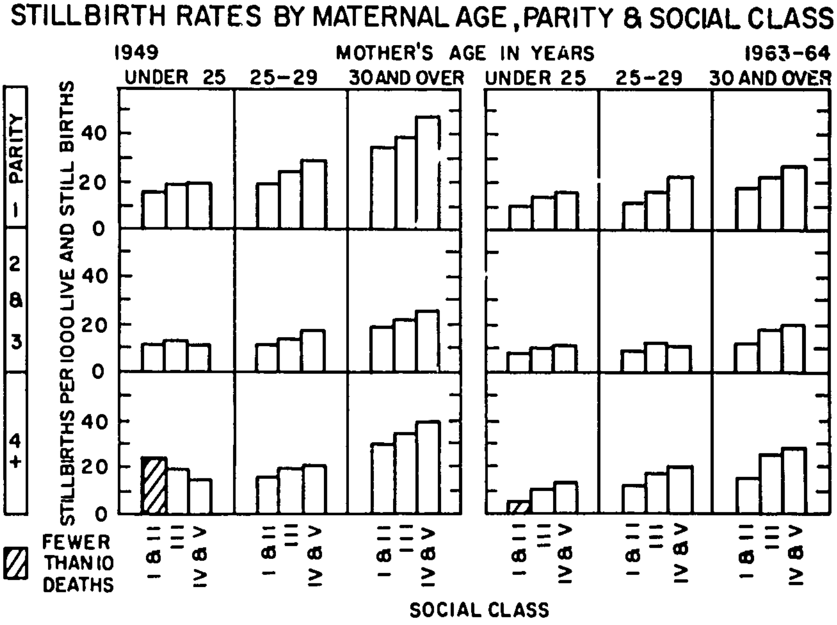
J. N. Morris and J. A. Heady, "V. Mortality in Relation to the Father's Occupation, 1911-1950," *ibid.*, pp. 554-60.

J. A. Heady and J. N. Morris, "Variation of Mortality with Mother's Age and Parity," *Journal of Obstetrics and Gynaecology of the British Empire 66* (1959): pp. 577-93.

[6] Morris and Heady, *1955-I*, p. 343; quoted by permission of Dr. Morris.

[7] Heady *et al.*, *1955-IV*, p. 502; quoted by permission of Dr. Morris.

Figure 2. Stillbirth rates varied according to the social class of the father and the mother's age and parity for single, legitimate births in England and Wales. Shaded columns indicate rates based on fewer than ten deaths.



SOURCE: Drawn from data in Table 2.

pages (Tables 2, 3, and 4 and Figures 2, 3, and 4) show how the observed trends in perinatal and infant mortality hold for all age groups and social classes in 1949 and 1964. The data for the tables and graphs for 1949 come from Morris and Heady's work;[8] the data for 1963-64 from the work of Spicer and Lipworth, who did a later study modeled on Morris and Heady's work so that the data from the two would be comparable.[9] Collectively these data indicate that stillbirths are highest among primiparas in all groups, but especially in "elderly" primiparas; stillbirth rates fall for the second and third births and rise again thereafter. The neonatal mortality rate is also affected by parity in much the same way as stillbirths, and the post-neonatal death rate rises steadily with increasing parity.

An indication of one of the factors in the post-neonatal death rates is given in Figure 5, which shows that the post-neonatal death rate

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[8] *Ibid.*, p. 500.

[9] C. C. Spicer and L. Lipworth, "Regional and Social Factors in Infant Mortality," *Studies on Medical and Population Subjects*, No. 19 (London: Her Majesty's Stationery Office, 1966), p. 13.

TABLE 2

Stillbirth Rates in England and Wales

		Stillbirths per 1,000 live and still births					
		1949			1963-64		
		Mother's age in years					
Mother's parity	Social class	Under 25	25-29	30 and over	Under 25	25-29	30 and over
1	I and II	15.2	19.5	35.5	10.5	12.3	18.0
	III	17.4	23.9	40.3	14.6	16.5	23.7
	IV and V	18.9	27.5	47.1	15.6	22.0	27.7
2, 3	I and II	10.8	10.2	18.3	8.6	8.8	12.6
	III	12.9	13.6	21.2	9.8	12.1	17.1
	IV and V	12.7	16.7	25.8	10.4	12.5	19.6
4 and over	I and II	(23.6)	15.4	29.2	(5.1)	12.1	16.4
	III	17.9	18.8	34.1	11.4	17.3	25.9
	IV and V	14.7	19.1	37.6	13.2	20.5	28.1

NOTE: Numbers in parentheses indicate rates based on fewer than ten deaths.

SOURCES: 1949 data are from J. A. Heady, C. F. Stevens, C. Daly, and J. N. Morris, "Social and Biological Factors in Infant Mortality: IV. The Independent Effects of Social Class, Region, the Mother's Age and Her Parity," *The Lancet* 268 (1955): 500; reprinted by permission of J. N. Morris and *The Lancet*.
1963-64 data are from C. C. Spicer and L. Lipworth, "Regional and Social Factors in Infant Mortality," *Studies on Medical and Population Subjects*, No. 19 (London: Her Majesty's Stationery Office, 1966), p. 13; reprinted by permission of the Office of Population Censuses and Surveys, England.

TABLE 3

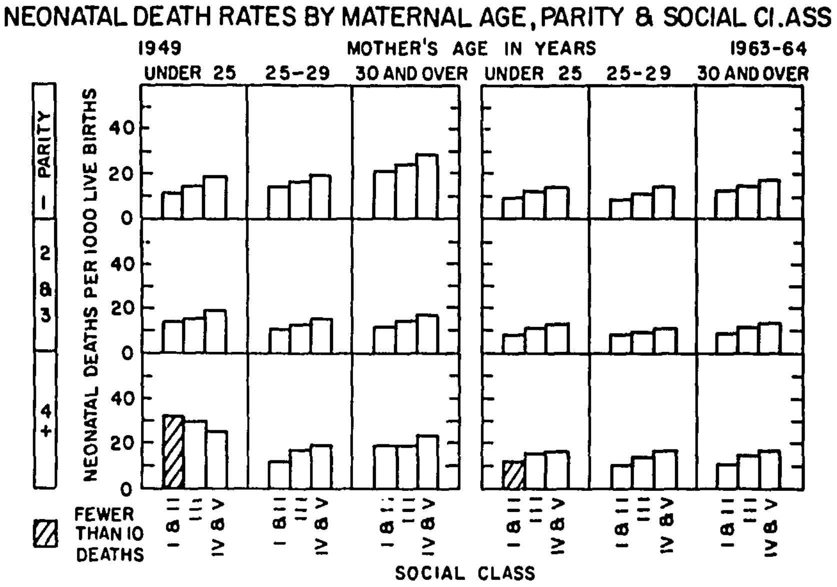
Neonatal Mortality Rates in England and Wales

Mother's parity	Social class	1949: Under 25	1949: 25-29	1949: 30 and over	1963-64: Under 25	1963-64: 25-29	1963-64: 30 and over
		Neonatal deaths per 1,000 live births					
		Mother's age in years					
1	I and II	12.3	14.5	21.0	9.6	9.4	12.6
	III	15.8	16.8	24.0	12.2	10.3	14.8
	IV and V	18.7	17.9	28.6	13.3	14.1	16.4
2, 3	I and II	14.0	10.5	12.0	8.8	7.3	8.8
	III	15.7	12.8	15.0	11.1	9.4	11.7
	IV and V	18.9	14.5	17.3	12.1	10.2	12.8
4 and over	I and II	(32.3)	12.8	18.3	(12.8)	11.9	10.9
	III	29.4	16.3	18.1	16.5	14.5	15.0
	IV and V	24.4	17.0	22.7	16.3	15.6	15.8

NOTE: Numbers in parentheses indicate rates based on fewer than ten deaths.

SOURCES: Same as Table 2.

Figure 3. Neonatal death rates varied according to the social class of the father and the mother's age and parity for single, legitimate births in England and Wales. Shaded columns indicate rates based on fewer than ten deaths.



SOURCE: Drawn from data in Table 3.

from infectious diseases rose steadily with increasing parity for each social class. A social class differential is evident, however, for the increase in deaths from infections was greater in the lower social classes than in the upper classes. The rate for congenital malformations did not change with either social class or parity.

The British Perinatal Mortality Survey, carried out in 1958, produced substantially the same results as the Morris and Heady studies in regard to the associations of maternal age, parity, and social class with perinatal mortality. The results of the Survey cannot be directly compared with the earlier studies, because the results are expressed in terms of a mortality ratio;[10] however, it is evident from Table 5 that the associations follow a similar pattern.

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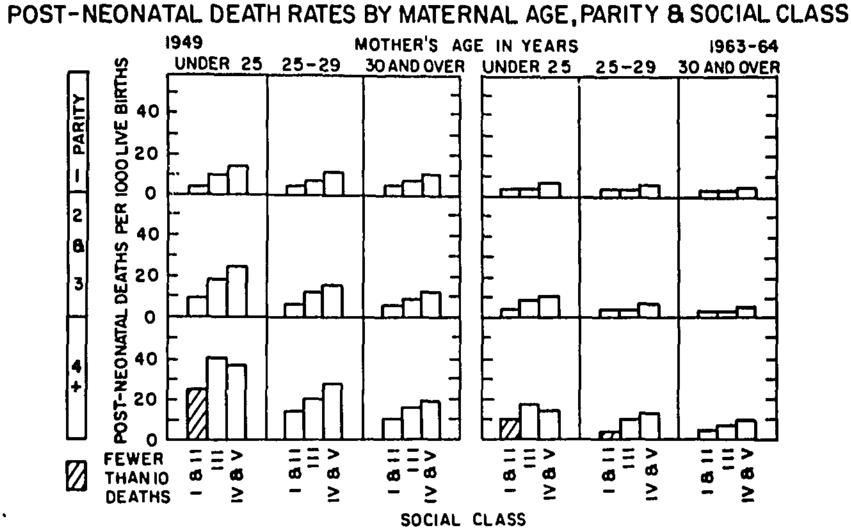
[10] The Mortality Ratio was defined as follows in N. R. Butler and D. G. Bonham, *Perinatal Mortality: The First Report of the 1958 British Perinatal Mortality Survey* (Edinburgh and London: E. & S. Livingstone, 1963), p. 299:

"In order to assess the seriousness of a condition in terms of mortality (stillbirth or neonatal) the incidence of the condition has been compared in the

Figure 4. Post-neonatal mortality rates varied according to the social class of the father and the mother's age and parity for single, legitimate births in England and Wales. Shaded columns indicate rates based on fewer than ten deaths.



SOURCE: Drawn from data in Table 4.

BRITISH STUDIES OF TRENDS IN PERINATAL AND INFANT MORTALITY

Part of Morris and Heady's study was a comparison of infant mortality by father's occupation in 1911 and in 1950. Their data show that although the *numbers* of deaths per 1,000 births had declined since the early 1900's for all social classes (most markedly among the lower classes), the *proportionate decline in the rates* of infant mortality was roughly the same in all the social classes. Morris and Heady's findings for the drop in neonatal and post-neonatal mortality rates between 1911 and 1950 are shown in Table 6.

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population and in the *deaths* as a ratio and related to the overall ratio of the Population and Death samples. The Survey Mortality Ratio is obtained thus:

$$M = \frac{\text{deaths (d)}}{\text{population (p)}} \times \frac{\text{Population (P)}}{\text{Deaths (D)}} \times 100 = 100 \times \frac{16944}{7117} \times \frac{d}{p}$$

where d/p is derived from the particular class or sub-class being considered and P/D is the Survey Population of one week's births — 16,944 divided by three months' Deaths — 7,117."

TABLE 4

Post-Neonatal Mortality Rates in England and Wales

		Post-neonatal deaths per 1,000 live births					
		1949			1963-64		
		Mother's age in years					
Mother's parity	Social class	Under 25	25-29	30 and over	Under 25	25-29	30 and over
1	I and II	4.6	4.2	4.4	3.9	2.6	2.4
	III	9.7	5.7	5.9	4.4	2.7	2.9
	IV and V	12.7	10.3	10.4	6.1	5.1	3.6
2, 3	I and II	8.6	5.8	5.7	4.3	3.9	2.9
	III	16.6	11.1	8.1	9.2	4.5	3.3
	IV and V	23.7	15.1	11.2	10.2	6.0	5.5
4 and over	I and II	(24.2)	14.2	10.6	(10.3)	(4.7)	4.4
	III	39.9	20.7	15.6	17.3	10.2	6.2
	IV and V	36.2	27.0	18.7	15.4	12.5	8.1

NOTE: Numbers in parentheses indicate rates based on fewer than ten deaths.

SOURCES: Same as Table 2.

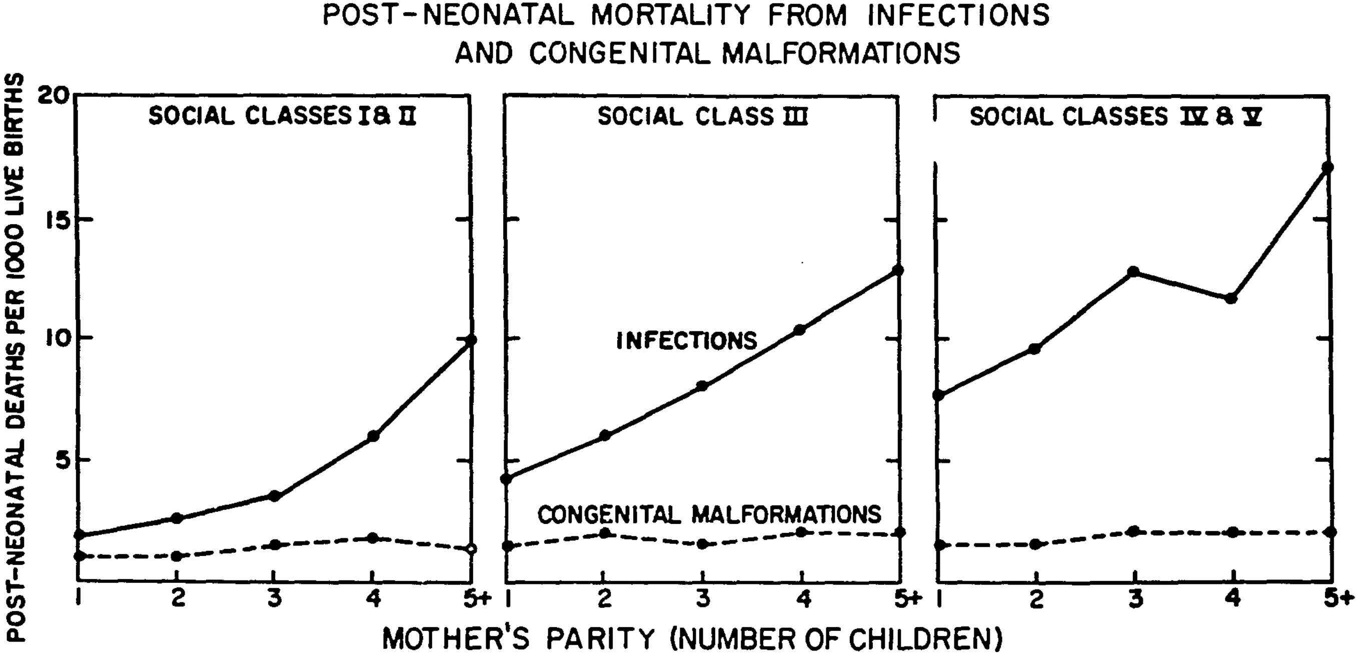
TABLE 5

Survey Mortality Ratio by Social Class, Parity, and Maternal Age
(The average mortality ratio for the Survey was 100; therefore numbers less than 100 represent below average mortality and those above 100, above average mortality.)

Mother's parity	Social class	Mortality ratio					
		Mother's age in years					
		<20	20-24	25-29	30-34	35-39	40+
1	I and II	76	81	79	94	90	119
	III	95	93	90	142	183	203
	IV	105	95	162	154	239	239
	V	146	128	137	116	80	318
2	I and II	—	57	46	66	139	174
	III	95	65	62	75	115	143
	IV	119	75	61	106	101	358
	V	114	87	98	90	112	298
3, 4	I and II	—	44	65	89	111	123
	III	179	77	92	106	110	206
	IV	119	93	106	104	100	159
	V	—	86	99	123	205	239
5+	I and II	—	—	32	72	130	107
	III	—	98	120	133	151	215
	IV	—	40	119	115	146	247
	V	—	129	159	188	231	273

SOURCE: Adapted from N. R. Butler and D. G. Bonham, *Perinatal Mortality: The First Report of the 1958 British Perinatal Mortality Survey* (Edinburgh and London: E. & S. Livingstone, 1963), p. 29; used by permission of E. & S. Livingstone.

Figure 5. Post-neonatal mortality from congenital malformations did not vary significantly with either social class or parity, but post-neonatal mortality from infections did increase with parity, and was higher for lower social classes for single, legitimate births in England and Wales, 1949.



SOURCE: J. N. Morris and J. A. Heady, "Social and Biological Factors in Infant Mortality: I. Objects and Methods," *The Lancet* 268 (1955): 346; reprinted by permission of Dr. Morris and *The Lancet*.

TABLE 6

Fall in Infant Mortality Rates, 1911-50, by Occupation of Father

Father's occupation	The percentage fall 1911-49/50 Neonatal deaths (under 4 weeks)	Post-neonatal deaths (4 weeks to 1 year)
Professional workers	50	83
Farmers	49	84
Teachers	54	85
Clerical workers	53	87
Textile workers	58	86
Miners	51	82
Farm workers	48	83
Building laborers	46	83
All occupations (not only those shown above)	53%	87%

SOURCE: J. N. Morris and J. A. Heady, "Social and Biological Factors in Infant Mortality: V. Mortality in Relation to the Father's Occupation, 1911-1950," *The Lancet* 268 (1955): 556; reprinted by permission of Dr. Morris and *The Lancet.*

Morris and Heady considered and rejected the possibility that the differences in infant mortality rates from one social class to another could be attributed to class differences in maternal age and parity. They offered instead speculations for the remarkably constant gaps in infant mortality rates among the social classes: The first was that there is a time-lag in the adoption of new health practices, dietary habits, etc., even when greater advantages become available to all social classes; furthermore,

> the notion of "generation mortality" — that the levels of death-rates during later life of a population cohort are settled early in its life — might possibly be extended here; in particular to the rates of stillbirth and neonatal death among women the foundation of whose own healthiness and unhealthiness was laid down during years of economic depression, and before the most recent and substantial social advances.[11]

Another suggestion offered by Morris and Heady is that social mobility might account to some extent for the similarity in mortality rate reduction, that is, healthy individuals moving into higher social classes than those into which they were born, and unhealthy individuals remaining in the same or moving into lower social classes.

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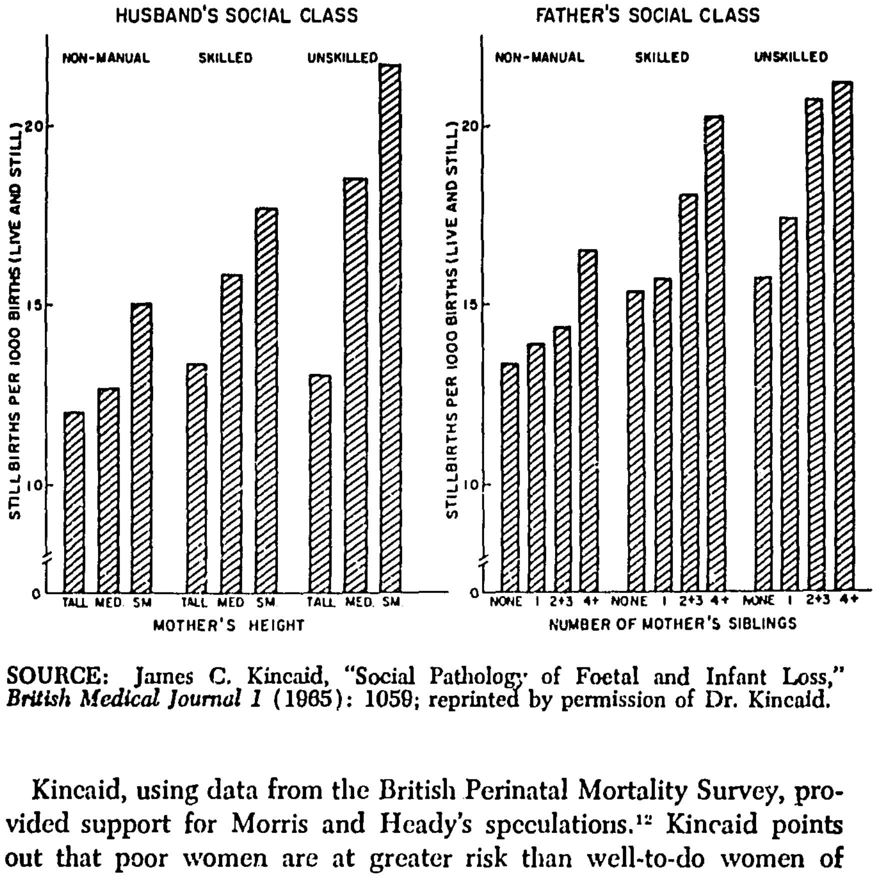
[11] Morris and Heady, *1955-V*, p. 558; quoted by permission of Dr. Morris.

Figure 6. The graph on the left shows stillbirth rates by maternal height within social classes for 16,845 single births. Women 65 inches (165 cm.) and over were classified as tall; those under 62 inches (157 cm.) as small. The graph on the right shows stillbirth rates by number of mother's siblings within mother's social class of origin for 13,823 single births.

STILLBIRTHS BY MOTHER'S HEIGHT AND HUSBAND'S SOCIAL CLASS
AND BY NUMBER OF MOTHER'S SIBLINGS AND FATHER'S SOCIAL CLASS



SOURCE: James C. Kincaid, "Social Pathology of Foetal and Infant Loss," *British Medical Journal 1* (1965): 1059; reprinted by permission of Dr. Kincaid.

Kincaid, using data from the British Perinatal Mortality Survey, provided support for Morris and Heady's speculations.[12] Kincaid points out that poor women are at greater risk than well-to-do women of having their infants die, for they are more likely to have large families, to live in crowded environments and are less likely to attend clinics regularly, etc. Kincaid also points out that women who are small have a greater risk of stillbirths than those who are tall, within all social classes, but that the difference is most pronounced among the lower classes. Mothers from large sibships are more likely to experience stillbirths than those from small sibships, suggesting poorer conditions for development in large families, another effect that is exaggerated among the poor, as shown in Figure 6. Data from the Perinatal Mortality Survey also indicate that women who move up socially through marriage are generally those who come from small families, who are better educated, and are therefore more likely to have successful pregnancies. These data lend some support to the speculation that social mobility affects the persistent social class differentials in perinatal mortality.

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[12] James C. Kincaid, "Social Pathology of Foetal and Infant Loss," *British Medical Journal 1* (1965): 1057-60.

NORTH AMERICAN STUDIES OF PERINATAL, INFANT, AND CHILDHOOD MORTALITY

An important statistical analysis of stillbirths in the United States was made by Yerushalmy for the five-year period 1937-41.[13] Since he was interested in examining the effects of birth interval as well as maternal age and parity, he selected a sample of 7,151,631 births — all births of order two or higher born to women between the ages of 15 and 44 in the United States between 1937 and 1941. Among this sample, there were 211,079 stillbirths, a rate of 29.5 per 1,000 births. Yerushalmy found that the stillbirth rate was lowest (22.2) for second births and that it rose steadily with parity to a high of 115.9 for fifteenth and later births, "an average increase of approximately 6 points for each birth order." When stillbirth rates were correlated with maternal age, it was found that it was high for infants born to very young mothers (33.7 stillbirths per 1,000 births for mothers 15-19 years of age); the rate was lowest for infants of mothers between 20 and 24 (23.3), and rose thereafter for each maternal age group to a high of 56.2 in the 40-44 year age group.

Yerushalmy calculated separately the "expected" stillbirths for different parities if only maternal age affected the stillbirth rate and for different age groups if only parity affected stillbirths, thus theoretically eliminating first the effect of parity, then the effect of age. Then by comparing theoretical ratios based on these calculations to actual ratios, he concluded that "the general effect of eliminating the age factor is to raise slightly the favorable ratios of the low parities and to lower considerably the high ratios in the high parities," and that "the effect of eliminating the influence of the parity factor is to raise the favorable ratios in the lower age groups and to lower the ratios in the older age groups."[14]

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[13] J. Yerushalmy, "On the Interval Between Successive Births and Its Effect on Survival of Infant — I. An Indirect Method of Study," *Human Biology 17* (1945): 65-106.

[14] *Ibid.*, pp. 85-87.

In the same paper, Yerushalmy reports on a separate analysis of the statistics on birth, stillbirth, maternal age, and parity for nonwhites in the United States in the ten-year period from 1932 to 1941. This analysis led to the same conclusions as the analysis of the data for all births; however, it also pointed up the fact that external environmental factors also seem to affect the stillbirth rate, since the overall rate for nonwhites was 56.6, nearly twice the level of stillbirths when the total births were considered.

In a subsequent retrospective study of pregnancy outcome on the island of Kauai, Hawaii, Yerushalmy and his associates carefully analyzed the previous reproductive histories of all women on the island. The retrospective data were tested and found reliable when taken from women under 50 years of age. The authors' specific comments on their data (summarized in part in the lower half of Figure 7) in explanation of the findings were that

> the higher rates for first pregnancies are found mainly in late fetal and neonatal mortality, to a somewhat lesser degree in the postneonatal period and are absent completely in both early fetal and in childhood mortality. This suggests that the higher rates do not reflect weakness of the first-born infant but rather the specific obstetrical hazards of the first birth.
>
> Early fetal deaths are influenced by order of pregnancy to a much lesser extent than any of the other indices. In fact, with the exception of first pregnancies and those of very high order, the early fetal death rates are only slightly affected by order of pregnancy. The pattern of childhood mortality at 1 to 4 years of age exhibits a very orderly and striking variation with order of pregnancies to an even stronger degree than that of the other indices. This indicates that the high rates for the high order of pregnancy may have an environmental origin.[15]

In a large American study Chase examined the outcome of nearly one-half million births which occurred in New York State (exclusive of New York City) between 1950 and 1952.[16] Her most interesting discovery can be summarized as follows: For fetal and neonatal mortality rates, there is a high risk for the first born, then after a drop for the second born, the risk gradually but progressively increases with birth order thereafter. For post-neonatal and early childhood mortality rates, the risk increases steadily with birth order, with no benefit for the second born. (See the upper part of Figure 7.)

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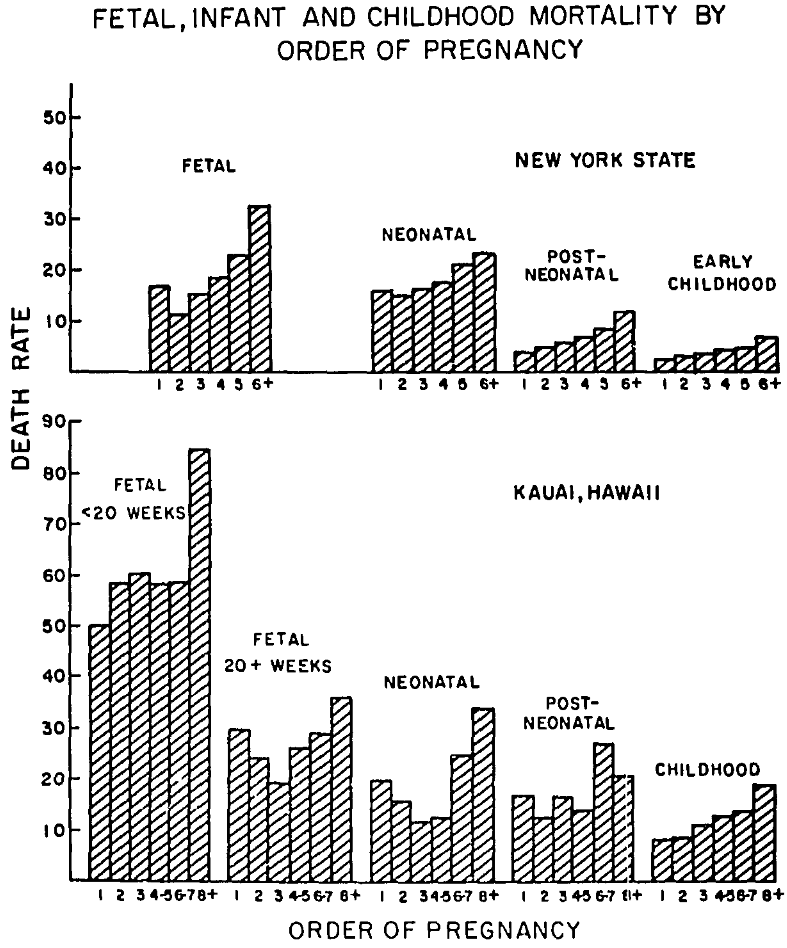
[15] J. Yerushalmy, Jessie M. Bierman, Dorothy H. Kemp, Angie Connor, and Fern E. French, "Longitudinal Studies of Pregnancy on the Island of Kauai, Territory of Hawaii — I. Analysis of Previous Reproductive History," *American Journal of Obstetrics and Gynecology 71* (1956): 87; quoted by permission of Dr. Yerushalmy.

[16] Helen C. Chase, "The Relationship of Certain Biologic and Socioeconomic Factors to Fetal, Infant and Early Childhood Mortality — I. Father's Occupation, Parental Age, and Infant's Birth Rank; II. Father's Occupation, Infant's Birth Weight and Mother's Age" (Mimeographed, Albany: New York State Department of Health, 1961 and 1962).

Figure 7. Fetal, infant, and early childhood mortality rates are shown by order of pregnancy. The upper graph is drawn from Chase's data, the lower graph from Yerushalmy's. The death rates were calculated as follows: fetal — deaths per 1,000 total births (Chase) and per 1,000 pregnancies (Yerushalmy); neonatal — deaths under 28 days per 1,000 live births; post-neonatal — deaths from 28 days through 11 months per 1,000 survivors to 28 days; early childhood — deaths from one to four years of age per 1,000 survivors to one year.



SOURCES: Drawn from data in Helen C. Chase, "The Relationship of Certain Biologic and Socioeconomic Factors to Fetal, Infant and Early Childhood Mortality — I. Father's Occupation, Parental Age, and Infant's Birth Rank; II. Father's Occupation, Infant's Birth Weight and Mother's Age" (Mimeographed, Albany: New York State Department of Health, 1961 and 1962) and J. Yerushalmy, Jessie M. Bierman, Dorothy H. Kemp, Angie Connor, and Fern E. French, "Longitudinal Studies of Pregnancy on the Island of Kauai, Territory of Hawaii — I. Analysis of Previous Reproductive History," *American Journal of Obstetrics and Gynecology 71* (1956): 87.

Another extensive American study was reported by Loeb and covered all children born between January 1 and March 31, 1950, in the United States (except Massachusetts) who died during the first year of life.[17] The death certificates of these children were matched with their birth certificates, and data on the infants' weight at birth, birth order, maternal age, and race (which may be taken as a rough measure of social class) were collected and analyzed. The overall neonatal mortality rate was 20.0 per 1,000 births; if the Massachusetts data were included, the overall rate was 19.9, but the Massachusetts data were omitted from the detailed analyses since data on birth weight were not uniformly recorded on Massachusetts birth certificates.

The general patterns of neonatal mortality in relation to parity and to maternal age were similar to those described by studies reviewed earlier in this chapter, as shown in the graphs in Figure 8. The lowest neonatal mortality for all parities combined occurred in children born to mothers between 25 and 29 years of age; the rates were higher for infants of younger and older mothers. As to birth order, for all maternal age groups combined, deaths were lowest for second births, moderately high for first births, and increased steadily with parity after the second birth. Nonwhites experienced higher neonatal mortality rates than whites for each maternal age and birth order. When both maternal age and birth order were considered, the lowest neonatal deaths among first order births were for the infants of young mothers (under 25) and highest for old mothers (over 35). Second births had the lowest neonatal mortality rates for all but the 40 to 44 age group, and after the second birth they rose more or less steadily with parity within each age group.

More recently, Shah and Abbey did a detailed statistical study of matched birth and neonatal and post-neonatal death records for infants born in Baltimore City between 1960 and 1964.[18] In addition to maternal age and live birth order, the study considered birth weight, race, socioeconomic status, and prenatal care. The study is important because it sought to separate the effects of each of these variables from the others. To do this, a binary variable multiple regression analysis was used

For neonatal mortality the authors concluded that "birthweight was . . . the single most important factor," because low birth weight infants (2,500 grams or less) had a risk of dying that was 604.14 percentage

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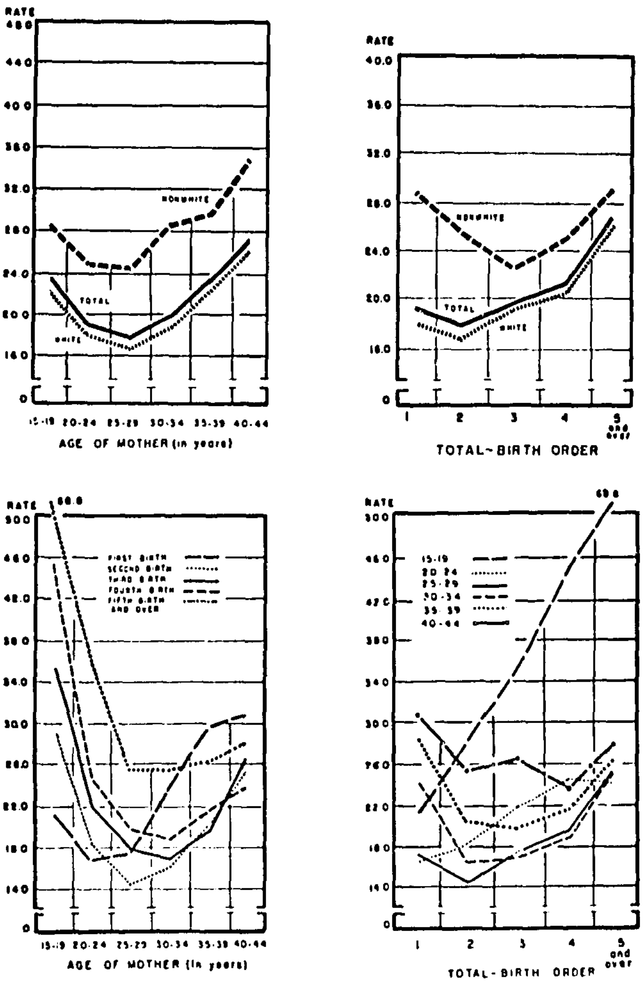
[17] Jeanne Loeb, "Weight at Birth and Survival of Newborn, by Age of Mother and Total-Birth Order: United States, Early 1950," *Vital and Health Statistics*, Series 21, Number 5 (1965).

[18] Farida K. Shah and Helen Abbey, "Effects of Some Factors on Neonatal and Postneonatal Mortality," *Milbank Memorial Fund Quarterly* 49 (1971): 33-57.

Figure 8. The two graphs at the top show neonatal mortality rates for whites and nonwhites by age of mother and total birth order. The graphs at the bottom show the neonatal mortality rates for each birth order by age of mother and for each maternal age group by birth order.

NEONATAL MORTALITY RATES AMONG CHILDREN BORN IN THE UNITED STATES DURING THE PERIOD JANUARY 1 TO MARCH 31, 1950, BY AGE OF MOTHER, TOTAL BIRTH ORDER, AND COLOR



SOURCE: Jeanne Loeb, "Weight at Birth and Survival of Newborn, by Age of Mother and Total-Birth Order: United States, Early 1950," *Vital and Health Statistics,* Series 21, Number 5 (1965), Figures 2, 4, 9, and 10, pp. 30, 32, 37, and 38.

points above average while babies weighing more than 2,500 grams had a risk of dying that was 75.90 percentage points below the average. When all other variables were controlled for — together and in turn — the risks for the low and high birth weight infants remained essentially unchanged. None of the other variables — except perhaps prenatal care — was considered to be important in neonatal mortality except as they related to birth weight. It is very unfortunate that this valuable study did not also consider birth weight as a dependent variable.

For post-neonatal mortality, birth weight was also considered to be a very important factor, and "next to birthweight, maternal age and live birth order were the most important factors. . . ." The risk of post-neonatal mortality increased with parity (except for fourth order births), and the difference in risk of post-neonatal mortality between first and fifth order births was about 77 percentage points when the crude association between birth order and mortality was considered and 109 percentage points when all other variables were adjusted for. The associations between maternal age and post-neonatal mortality showed the greatest risk in both adjusted and unadjusted risk for very young mothers (under 20), a subsequent decrease in risk to a low in the 30 to 34 age group, and a rise again in the infants of mothers over 35.

Health personnel are becoming more and more interested in the potential value of prenatal care in preventing pregnancy wastage and in optimizing maternal and infant health. Thus it is interesting to note that Shah and Abbey found that the risk of both neonatal and post-neonatal death was considerably greater among infants whose mothers had had no prenatal care as opposed to those whose mothers had had prenatal care.

A Canadian study by Newcombe of children born in British Columbia provides information on the association of maternal age and birth order with stillbirths, infant and child deaths, and child handicaps.[10] The part of the study which deals with mortality is based on stillbirth records and on child death records linked with live birth records (which include data on birth order and maternal age). Analyzing published records which reported live births and infant deaths between 1952 and 1960, Newcombe found a steady increase in risk of infant death with increasing birth order — an effect that was accentuated when the effects of maternal age were excluded. The risk of infant death according to maternal age was highest for infants born to mothers under 20, dropped to a low in the maternal age range 25-29 years, and then rose again with age. When the effects of pregnancy order were eliminated the effects of maternal age were more pronounced at ages less than 25 and over 45 and less pronounced at the intermediate ages.

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[10] Howard B. Newcombe, "Environmental versus Genetic Interpretations of Birth-Order Effects," *Eugenics Quarterly 12* (1965): 90-101.

In another phase of the study, Newcombe excluded the effects of maternal age in analyzing data on stillbirths (2,398), and on linked records of child deaths (6,404) and live births (213,353) for children born between 1953 and 1958. He found that the relative risk of stillbirth was high for first births, lowest for second, and that it rose with birth order thereafter. The risk of child death rose dramatically and uninterruptedly with birth order. Detailed examination of the data on infant deaths showed that the relative risk of death in the first six days of life was essentially the same for the first three births, then rose gradually and only slightly; that between the seventh and the 27th days the increase in relative risk with birth order was gradual up to the fourth birth but quite marked thereafter; and that for infants between one month and one year of age, the risk of death rose very rapidly with birth order, most markedly after the fifth birth. This detailed analysis and the findings on childhood mortality risk led Newcombe to suggest that the increase in risk with birth order to infants beyond the neonatal period and to children reflected environmental factors.

INDIAN STUDIES ON PERINATAL MORTALITY

As Bajpai points out, registration of stillbirths and infant deaths in India is uncertain, and all studies from India are therefore based only on hospital statistics and cannot be considered representative of conditions for the total population. With this limitation in mind, several important studies can be reviewed. Two general articles, one by Jain[20] and one by Lal,[21] review some of the important social and biological factors in India's infant mortality problem. Both mention family size and malnutrition of mother and infant as important factors associated with infant mortality. Lal further points out that not only is constant childbearing an unhealthy burden on the mother, but that large families, malnourished and living in crowded quarters, are very susceptible to infection.

Two relatively careful studies of the causes of perinatal mortality, both in terms of specific medical cause and general biological and

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[20] V. C. Jain, "Some Social Components of Infant Mortality in India," *Indian Journal of Pediatrics* 35 (1968): 109-12.

[21] A. Lal, "Infant Mortality: Some Socio-economic and Biological Determinants," *Indian Journal of Child Health* 11 (1962): 73-80.

TABLE 7

Relationship of Perinatal Loss to Parity

Parity	Number of births	Perinatal deaths	
		Number	Percentage
1st para	232	29	12.5
2nd para	189	9	4.8
3rd-5th para	364	39	10.7
6th-9th para	186	30	16.1
10th para and above	29	7	24.8
Total	1,000	114	11.4

SOURCE: P. C. Bajpai, D. Kutty, K. C. Rajgopalan, and K. M. Wahal, "Observations on Perinatal Mortality," *Indian Pediatrics* 3 (1966): 86; reprinted by permission of Dr. Bajpai.

social causes, were conducted by Bajpai and associates at Queen Mary's Hospital in Lucknow and by Mehdi and associates in Hyderabad.

Bajpai and his associates studied the outcome of 1,000 consecutive single births at Queen Mary's Hospital in Lucknow in 1964.[22] Because of emergency admissions from surrounding areas, for example of women expected to have difficult labor, the hospital had a very high perinatal mortality for these 1,000 births of 114; of these, 71 were stillbirths and 43 were infants who died in the first week of life. The authors cite several factors associated with this high death rate: (1) the risk of perinatal mortality increases at maternal ages greater than 25 years and sharply after 35 years; (2) perinatal mortality was highest in first births, lowest for second, and increased thereafter, as indicated in Table 7; (3) low birth weight was another major cause of perinatal mortality; (4) 76 percent of the losses "occurred in the poorer class of people." The final conclusion was that a large percentage of the mortality could be prevented by better prenatal care and better management of premature infants.

Mehdi and associates undertook a study of perinatal mortality in 1953 and continued it first at Osmania General Hospital and then at the Government Maternity Hospital until 1959; information on the parity of the mother was available for 13,634 consecutive deliveries at the Government Maternity Hospital.[23] Also investigated were birth

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[22] P. C. Bajpai, D. Kutty, K. C. Rajgopalan, and K. M. Wahal, "Observations on Perinatal Mortality," *Indian Pediatrics* 3 (1966): 83-98.

[23] Z. Mehdi, P. M. Naidu, and V. Gopal Rao, "Incidence and Causes of Perinatal Mortality in Hyderabad, Andhra Pradesh, India," *Indian Journal of Medical Research* 49 (1961): 897-946.

TABLE 8

Perinatal Mortality in Relation to the Parity of the Mother Government Maternity Hospital, Hyderabad, July 1957 to September 1958

Parity of mothers	Total births	Perinatal loss	Perinatal mortality per 1,000 births
1st	2,778	231	83.1
2nd to 4th	6,331	215	33.0
5th to 7th	3,245	168	51.7
8th and above	1,280	89	69.5
Total	13,634	803	58.8

SOURCE: Z. Mehdi, P. M. Naidu, and V. Gopal Rao, "Incidence and Causes of Perinatal Mortality in Hyderabad, Andhra Pradesh, India," *Indian Journal of Medical Research* 49 (1961): 905.

weight, maternal age, autopsy data, and other obstetric and clinical data as well as the socioeconomic conditions for 493 of the cases of perinatal mortality.

Once again, as can be seen from Table 8, the highest perinatal loss was for first births, lowest in this case for the group of second to fourth births, with loss increasing for fifth and later births.

The authors felt that the principal biological causes of perinatal death were related to maternal age and parity; also cited as very important were the socioeconomic conditions and the nutritional status of the mother. One of the major recommendations for prenatal care was in the area of diet to correct "not only the obvious deficiencies but to maintain optimum nutrition of the mother and the foetus."

AFRICAN STUDIES OF PERINATAL MORTALITY

Two African studies have been reviewed for the effects of parity on perinatal and infant mortality, one conducted in Ghana, the other in a Bantu sample of the population of Tanganyika; both studies were of quite limited scope. Radovic studied patients under his care at the Tema General Hospital in Ghana over a ten-month period and found increasing infant mortality and maternal complications with increasing parity.[24] His sample consisted of 220 primiparas, 217 multiparas with fewer than four deliveries, and 132 multiparas with four or more deliveries; his data are based on both previous reproductive history of the women and the latest delivery for which they were under his care. Stillbirths ranged from 1.81 percent in primiparas to 6.45 percent in those with fewer than four deliveries, to 11.36 percent in those with more than four deliveries. The "grand multipara" group had experienced a total of 30.45 percent infant loss previously and 11.26 percent in last deliveries.

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[24] Petar Radovic, "Frequent and High Parity as a Medical and Social Problem," *American Journal of Obstetrics and Gynecology* 94 (1966): 583-85.

The Tanganyika study was based on complete records for 1,624 births over the period of 1952-57 for Hangaza, a Bantu-speaking people in the northwest section of the country.[25] Roberts and Tanner were studying the effects of parity not only on perinatal mortality, but on other factors such as birth weight and twinning. They found an increase in twinning with parity and an increase generally in birth weight with parity. However, they also found that perinatal loss was highest in first pregnancies and in women of parity greater than five. The data for this relatively small sample were compared with data from studies of perinatal loss in England and the results, with regard to the association with parity, were found to be similar.

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[25] D. F. Roberts and R. E. S. Tanner, "Effects of Parity on Birth Weight and Other Variables in a Tanganyika Bantu Sample," *British Journal of Preventive and Social Medicine 17* (1963): 209-15.

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FAMILY PLANNING VARIABLES AND MATERNAL COMPLICATIONS WITH SPECIAL REFERENCE TO THE GRAND MULTIPARA

As early as 1865, J. Matthews Duncan pointed out the hazards of grand multiparity thus: "If a woman has a large family she escapes extraordinary risk in surviving her first labour, to come again into extraordinary and increasing risk as she bears her ninth and subsequent children."[1] The risks of grand multiparity were not widely recognized, however, and according to Eastman many obstetricians thought that the grand multipara "represents an 'easy obstetrical case' (one in which the only serious problem is to get there in time)."[2]

Eastman himself and many other investigators have brought this view of the grand multipara as an easy obstetrical case under severe attack over the last three decades. These authors have reported that high parity — particularly "grand multiparity" which is variously defined as births following five, six, or even more previous pregnancies or deliveries — carries increased risks of maternal mortality and obstetric complications such as pre-eclampsia, eclampsia, placental disorders, uterine rupture, malpresentation, and hemorrhage.[3] Evidence on the toll in maternal health in areas not specifically related to obstetric factors includes a number of studies on the association of parity and diabetes and of parity and cancer of the cervix.

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[1] J. Matthews Duncan, "On the Mortality of Childbed as Affected by the Number of the Labour," *Edinburgh Medical Journal 11* (1865): 210.

[2] Nicholson J. Eastman, "The Hazards of Pregnancy and Labor in the 'Grande Multipara,' " *New York State Journal of Medicine 40* (1940): 1708.

[3] Some authors feel that the risks of grand multiparity have been exaggerated, that age more than multiparity is responsible for the complications noted, or that multiparity aggravates pre-existing conditions but causes few obstetric complications directly. Among these are Joseph M. Krebs, "Grand Multiparity: Survey and Appraisal," *Obstetrics and Gynecology 7* (1956): 433-43; K. Fuchs and A. Peretz, "The Problem of the 'Grand Multipara': A Review of 1677 Cases," *Obstetrics and Gynecology 18* (1961): 719-25; and E. L. R. Schram, "The Problem of the Grand Multipara," *American Journal of Obstetrics and Gynecology 67* (1954): 253-62.

HAZARDS OF GRAND MULTIPARITY IN WESTERN COUNTRIES

Many of the early studies of the hazards of grand multiparity were prompted by observed or suspected higher mortality associated with it. The purpose was to discover the reasons for the high risk of mortality among women of high parity, and to recommend preventive measures. For example, Eastman reviewed the records of 45,514 consecutive obstetric cases at Johns Hopkins for the period 1896 to 1939 and found that for women of low parity (first to fifth births), maternal mortality ranged from 3.55 to 3.78 deaths per 1,000 live births, averaged more than four per 1,000 for sixth to eighth births, and rose to 11.73 per 1,000 for ninth and later births.[4] He found that more than half the deaths of women who had previously had five or more children were attributed to — in order of importance — rupture of the uterus, chronic hypertensive vascular disease or chronic nephritis, and placenta previa. He recommended that all women be offered contraceptive advice or the option of sterilization after bearing their eighth child, that pregnancies in women with definite hypertensive disease be terminated, and that facilities for transfusion be readily available when women of high parity were delivering.

Later studies indicate that as a result of the general decline in fertility in western countries in recent decades, there has been a significant reduction in the incidence of grand multiparity per 1,000 hospital obstetric cases. There has also been a significant reduction in mortality among grand multiparas treated in modern, well-equipped hospitals, due largely to the success of good prenatal care and obstetric management. Despite this reduction in mortality, the relative risk associated with multiparity continues to exist. Furthermore, morbidity has not declined as much as has mortality.

Jaffe and Polgar, for example, found that among a sample of nearly 350,000 births in the United States between 1951 and 1961, maternal mortality increased with both age and parity, as shown in Figure 9.[5] Their data indicated that maternal mortality increased steadily with maternal age from 5.1 per 10,000 live births for mothers under 20 years of age to 34.3 for those 40 years and over. However, a comparison of

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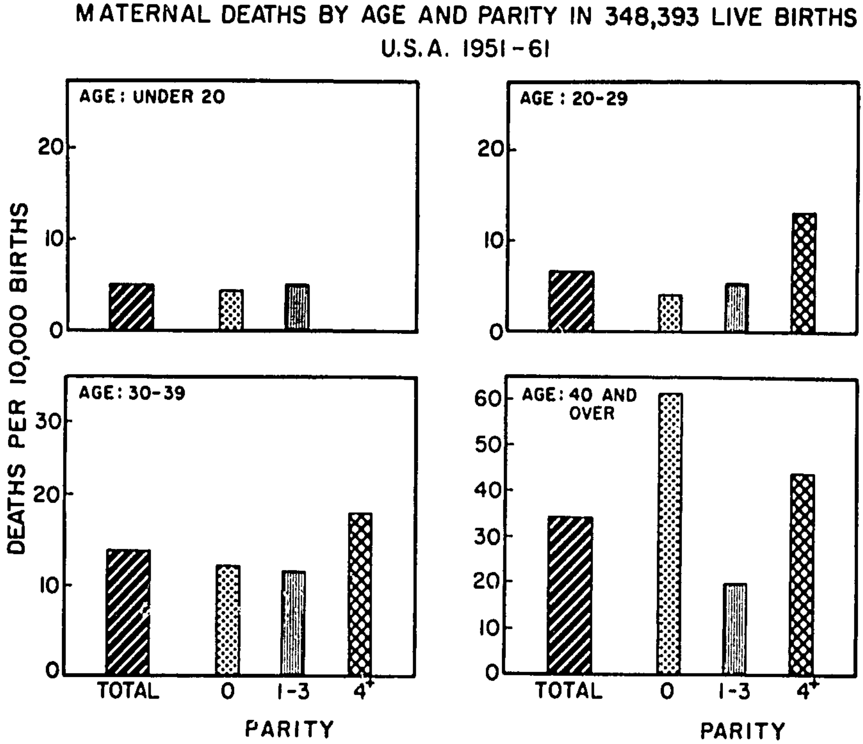
[4] Eastman, pp. 1708-12.

[5] F. Jaffe and S. Polgar, "Medical Indications for Fertility Control" (unpublished paper, Planned Parenthood-World Population, 1964).

Figure 9. Maternal deaths per 10,000 births, according to maternal age and parity among 348,393 live births in the United States between 1951 and 1961, generally increased with parity within each maternal age group.



SOURCE: Drawn from data in F. Jaffe and S. Polgar, "Medical Indications for Fertility Control" (unpublished paper, Planned Parenthood-World Population, 1964), pp. 3-4.

maternal mortality for second to fourth births with that for fifth and later births *within* each of four maternal age groups (under 20, 20-29, 30-39, and over 40), revealed higher maternal mortality for the higher parities — in some cases more than twice as high as the mortality for low parity.

One extensive study of the hazards associated with grand multiparity which showed the change in mortality and morbidity over time was that by Oxorn who made a survey of 63,140 women delivered in the Victoria Montreal Maternity Hospital between 1926 and 1952.[6] A com-

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[6] Harry Oxorn, "Hazards of Grand Multiparity," *Obstetrics and Gynecology* 5 (1955): 150-56.

TABLE 9

Comparison of Obstetric Complications Between Grand Multiparas and Others

Complication	Grand multiparas (percent)	Others (percent)
Toxemia	14.2	4.0
Abruptio placentae	2.2	0.6
Placenta previa	1.9	0.6
Transverse lie	2.2	0.2
Breech	9.8	4.3
Mid-forceps	1.5	9.6
Cesarean section	2.5	4.3
Postpartum hemorrhage	6.1	3.8
Ruptured uterus	0.2	0.03
Maternal mortality	0.9	0.21
Fetal mortality	12.4	3.8

SOURCE: Harry Oxorn, "Hazards of Grand Multiparity," *Obstetrics and Gynecology* 5 (1955): 150-56; reprinted by permission of Dr. Oxorn.

parison between the grand multiparas (those with eight or more children) and women of lower parity showed a higher percentage of mid-forceps and cesarean section deliveries for the low parity groups, but higher percentages of the following complications for the grand multiparas: toxemia, abruptio placentae, placenta previa, malpresentation, postpartum hemorrhage, ruptured uterus, maternal mortality, and fetal mortality. (See Table 9.)

When he compared the complications and delivery techniques for grand multiparas treated before 1942 and those treated thereafter, Oxorn found that the most dramatic changes had occurred in delivery techniques and in maternal mortality, there having been no deaths in the 1943-52 period. The occurrence of postpartum hemorrhage was virtually the same for both periods, and the drops in puerperal morbidity (from 10.07 percent to 7.6 percent) and in toxemia of pregnancy (from 15.59 percent to 13.05 percent) were "less impressive." (See Table 10.)

In order to try to separate the effects of age and parity, Oxorn divided his grand multipara group by age into those under 35, those 35 to 40, and those over 40. He also compared grand multiparas over 40 to women over 40 with two or three children. He found high relative risks among older grand multiparas of toxemia, occiput posterior and transverse positions, cesarean section, and mid-forceps deliveries.

TABLE 10

Complications of Grand Multiparity for Two Different Periods

Complication	1926-42 (percent)	1943-52 (percent)
Incidence of grand multiparity	2.14	1.1
Maternal mortality	1.38	0.0
Fetal mortality	14.77	8.5
High forceps	0.69	0.0
Version and extraction	4.69	0.6
Cesarean section	2.21	3.3
Postpartum hemorrhage	6.07	6.1
Puerperal morbidity	10.07	7.6

SOURCE: Same as Table 9.

However, comparing the grand multiparas over 40 to the women of low parity over 40, he concluded that high parity rather than age was of greatest importance as a cause of complications of pregnancy. His analysis suggested that parity alone seemed to affect fetal and maternal mortality, but that for many other complications, "age and parity working together have a greater effect than parity alone." His conclusion for the entire study was that although there had been a reduction in the incidence of grand multiparity and in mortality associated with it, "some complications are difficult to avoid unless pregnancy is prevented."

Some other series did not show complete elimination of maternal mortality in multiparas as did Oxorn's. In a review of 6,512 deliveries at Oneida Maternity Hospital in southeastern Kentucky, for example, maternal mortality in the grand multipara (para seven and over), remained twice as great as that for all deliveries.[7] Infant mortality was nearly three times greater for infants of the grand multiparas than for those of mothers para zero to six. Immaturity (1,000 to 2,000 grams) was twice as great in the grand multipara group compared to women who had had three or fewer previous children. The investigators also found much higher incidence in the grand multiparas than in women of low parity of toxemias of pregnancy, hypertensive disease, abruptio placentae, placenta previa (which increased "in a direct proportion to the number of previous births"), ruptured uterus, and malpresentation.

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[7] John A. Petry and B. Pearson, "Obstetrical Complications with Grand Multiparity," *Southern Medical Journal* 48 (1955): 820-26.

In another study from southeastern Kentucky, this one for the period 1956-61, Ziel compared deliveries of women who had had at least six previous pregnancies of 20 or more weeks duration with deliveries to women of lower parity.[8] He found statistically significant higher occurrence of malpresentation, hypertension, pre-eclampsia, anemia, hemorrhage, and heart disease and diabetes as complications of pregnancy among the grand multiparas.

Ziel also analyzed complications within the grand multiparity group in relation to maternal weight (including weight gain during pregnancy), age, and number of prenatal visits. Heart disease and diabetes were significantly associated with maternal weight, as was hypertension, which was also associated with increasing age. Pre-eclampsia was associated with weight at delivery, weight gain during pregnancy, and age.

In their series of 812 women who had "eight or more viable gestations" Nelson and Sandmeyer reported more abnormal presentations, antepartum and postpartum hemorrhage, and hypertensive disease as compared to the total group of 19,214 deliveries at a Washington, D.C., hospital between 1951 and 1955.[9] Puerperal morbidity for the total group was, however, greater than for the grand multiparity group.

Vehaskari and his colleagues, reporting on experience in a Finnish hospital for the period 1951-60, also defined para eight as the lower limit of grand multiparity.[10] They found statistically significant increases in the following complications for their 1,567 grand multiparas as compared to 16,432 lower parity women: hypertensive disease, abruptio placentae, placenta previa, retained placenta, and breech presentation. Hypertensive disease was felt to be highly correlated with maternal age, whereas placental complications seemed to be correlated chiefly with parity.

Some authors have presented their findings on grand multiparas without regard to controls or only in comparison to previous reports on the hazards of grand multiparity. Miller reviewed the cases of 563 grand multiparas — those who had "delivered six viable infants" — at a New Mexico hospital between 1944 and 1953.[11] She compared her findings on obstetric risks in these patients to previously published reports and in general found her results in accord with the published reports. O'Sullivan, reporting on experience with 611 patients delivered in an Irish hospital between 1956 and 1960, concluded that the following presented serious problems in his series: anemia, antepartum and postpartum hemorrhage, unstable lie, and hypertensive toxemia, the latter attributable to the advancing age characteristic of women of high parity.[12] Quinlivan reached similar conclusions on the hazards of grand multiparity.[13]

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[8] Hermann A. Ziel, "Grand Multiparity — Its Obstetric Implications," *American Journal of Obstetrics and Gynecology* 84 (1962): 1427-41.

[9] James H. Nelson and Melvin W. Sandmeyer, "A Study of 812 Grand Multiparas," *American Journal of Obstetrics and Gynecology* 75 (1958): 1262-66.

[10] Allan Vehaskari, Jorma Lahtinen, and Juhani Terho, "Hazards of Grand Multiparity," *Annales Chirurgiae et Gynaecologiae Fenniae* 57 (1968): 476-84.

[11] Elinor Miller, "Grand Multiparas: A Ten-Year Study," *Obstetrics and Gynecology* 4 (1954): 418-25.

Many investigators face the problem of having very small samples of grand multiparas or of using the records of patients seen over a long time span during which obstetric care and techniques may have changed radically. In an attempt to overcome these difficulties, Israel and Blazar reviewed the cases of 5,551 grand multiparas (para seven and greater) out of 128,568 women who delivered children between 1958 and 1960 in thirteen U. S. hospitals which collaborate in the Obstetrical Statistical Survey.[14] Detailed records on standard forms were provided by the hospitals for each obstetric patient; for the analysis of obstetric hazards associated with grand multiparity, data on medical history, prenatal care, labor, delivery, and complications were transferred to punch cards, the records of women of para seven and higher were separated from the rest, and the two groups were compared. The authors concluded: "An obstetrically disconcerting, statistically significant heightening of the incidence of anemia, pre-eclampsia, chronic hypertension, placental disasters, uterine rupture, and postpartum hemorrhage has emerged as characteristic of excessive multiparity." They also found more frequent malpresentation among multiparas than among women of low parity. Age was considered to be important in the higher incidence of hypertension and subsequent toxemia.

THE SITUATION IN DEVELOPING COUNTRIES

Judging from circumstantial evidence and from a few reports, we can speculate that grand multiparity continues to be highly prevalent in the developing world and that morbidity and mortality associated with it are unnecessarily high.

The prevalence of high parity is a function of high fertility, which is common to almost all the developing countries. John St. George, for example, reported that "one of every five pregnancies in Trinidad and Tobago occurs in a grand multipara, a woman who has previously had at least six gestations terminating beyond Week 28."[15] In Egypt, according to 1960 census data, the distribution of wives by number of live births was as follows:

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[12] John F. O'Sullivan, "The Hazards Associated with Multiparity," *Journal of Obstetrics and Gynaecology of the British Commonwealth 70* (1963): 158-64.

[13] William L. Quinlivan, "Incidence of Abnormalities in Women of Gravidity Seven or More," *Obstetrics and Gynecology 23* (1964): 567-69.

[14] S. Leon Israel and Andrew S. Blazar, "Obstetric Behavior of the Grand Multipara," *American Journal of Obstetrics and Gynecology 91* (1965): 326-32.

Parity	*Percentage of Wives*	
0	14	
1-2	21.4	
3-5	32.5	
6	8.8	32.1
7-9	16.8	
10+	6.5	

The table indicates that almost one-third of the wives had had six or more live births and that 23.3 percent had borne seven or more children (not including stillbirths). Hefnawi provided these figures and analyzed data on women bearing a sixth or later child in 1961 to show the need for contraception (including sterilization) for such women.[16] Among the women delivering a sixth or later live birth in 1961, 12.7 percent were under 25 years of age, 42.2 percent under 30, and 89 percent under 40; these figures show that even though these women had had six or more live births, they were not past the age of bearing more children.

Unfortunately, reliable data on obstetric and mortality experience by parity and age are very scanty from developing countries. It is expected nevertheless that the grand multiparas fare worse in these countries than in the West. In one series of grand multiparas from Ghana, Radovic analyzed the experience of patients at the Tema General Hospital during a ten-month period.[17] His sample included 220 primiparas — none of whom died; 217 multiparas with fewer than four deliveries — 0.46 percent of whom died; and 132 multiparas with four or more deliveries — 2.27 percent of whom died. Among primiparas 6.36 percent had cesarean sections, as compared to 13.63 percent of the multiparas with four or more deliveries. The high multipara group also experienced higher perinatal and infant mortality among their offspring than the lower parity groups, as reported in Chapter 2. The author felt that this evidence of increasing perinatal, infant, and maternal mortality with increasing parity indicated the need for birth control for all women in Ghana who were interested in planning their families.

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[15] John St. George, "Factors Influencing the High Incidence of Grand Multiparity in Trinidad and Tobago," *Obstetrics and Gynecology* 34 (1969): 685-89.

[16] Fouad el Hefnawi, "The Place of Sterilization in Egypt," *Journal of the Egyptian Medical Association* 48 (1965): 88-99.

[17] Petar Radovic, "Frequent and High Parity as a Medical and Social Problem," *American Journal of Obstetrics and Gynecology* 94 (1966): 583-85.

OTHER HEALTH HAZARDS FOR THE MULTIPARA

In addition to obstetric complications, two other health hazards which plague the multipara are diabetes and cancer of the cervix. Other problems of physical health and emotional adjustment which affect other family members as well as the mother are dealt with in Chapter 5.

DIABETES MELLITUS

Since it was first suggested in 1933 by Mosenthal and Bolduan that pregnancy might play a part in the development of diabetes,[18] a number of investigators have reported more women than men among cases of diabetes developed after age 40; furthermore, the women are generally married, and many of them have large families. Some authors have suggested that obesity is more important than high parity in the etiology of diabetes;[19] others — including those whose work is reviewed below — have felt that parity was of equal or greater importance.

A study by Munro, Eaton, and Glen of the records of 1,309 diabetics seen at Victoria Infirmary in Glasgow between 1932 and 1942 showed that until the age of 40 the incidence of diabetes among men and women was about the same but that after 40 the incidence among women was greater.[20] Among the factors investigated for a relationship with diabetes were family history, infection, height, weight, blood pressure, and reproductive history. The authors concluded that obesity might increase the likelihood of diabetes among predisposed individuals, but that the high incidence of diabetes in women over 40 could not be entirely accounted for by obesity and was also "related, at least in part, to previous childbearing."

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[18] H. O. Mosenthal and C. Bolduan, *American Journal of Medical Science 186* (1933): 605, cited in M. G. Fitzgerald, J. M. Malins, D. J. O'Sullivan, and Mary Wall, "The Effect of Sex and Parity on the Incidence of Diabetes Mellitus," *Quarterly Journal of Medicine 30* (1961): 67.

[19] See, for example, E. P. Joslin, L. I. Dublin, and H. H. Marks, *American Journal of Medical Science 191* (1936): 759, cited in *ibid.*

[20] H. N. Munro, J. C. Eaton, and A. Glen, "Survey of a Scottish Diabetic Clinic: A Study of the Etiology of Diabetes Mellitus," *Journal of Clinical Endocrinology* 9 (1949): 48-78.

Pyke made a study of 953 patients attending a clinic for diabetics in Radcliffe, England; of these, 583 were women, 477 of whom were over 45 years of age, and 370 were men, 251 of whom were over 45. Pyke found that there was a larger proportion of women of high parity who developed diabetes after age 45 than would be expected according to the proportion of women of high parity and within the same age group in a one percent sample from the 1951 census in England. "A woman with five children has about three times as much chance of developing diabetes as a woman with none."[21] He also concluded that the increase in diabetes among women of high parity could not be attributed simply to an increase in weight with parity, although in a later report he did suggest that weight may increase more with parity among diabetics than among non-diabetics.[22] He also suggested that his early estimate of the increase in risk of diabetes with parity might have been exaggerated, but that "it seems likely that women who have borne five or more children are at least twice as liable to develop diabetes as those who have borne none."[23]

Fitzgerald and his colleagues examined data on family history, age, and sex, and on parity and marital status of women for 5,441 diabetic patients who first attended the diabetic clinics at two Birmingham hospitals between 1949 and 1958.[24] For comparison, they considered the population of Birmingham as the population at risk, according to the number of residents of each age and sex as reported in the 1951 census. For comparisons of diabetic and non-diabetic women of various parities, the records of 7,608 married women over the age of 45 who had been admitted to all departments of a general hospital in Birmingham between 1953 and 1955 were used as controls.

As other authors had reported, Fitzgerald *et al.* found that after age 40 the incidence of diabetes was higher among women than among men, that diabetes increased with parity for the women, that high parity did not lead to earlier onset of diabetes, and that obesity alone did not explain the higher incidence among women as compared to men or among multiparous as compared to nulliparous women. Specifically, in relation to parity, they found that the occurrence of diabetes was equal in unmarried women and in married women who had had no children and that "compared with nulliparae, diabetes is about twice as common in women who have had three children, and six times as common in those who have had six or more." Furthermore, "at all ages a greater percentage of the diabetic women have had four or more, and especially seven or more, children." The authors suggested that more information on the distribution of parity and obesity in the general population is needed before further conclusions could be drawn on the relative importance of obesity and parity in the development of diabetes.

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[21] D. A. Pyke, "Parity and the Incidence of Diabetes," *The Lancet 270* (1956): 818-21.

[22] D. A. Pyke and N. W. Please, "Obesity, Parity and Diabetes," *Journal of Endocrinology 15* (1957): xxvi-xxxiii.

[23] D. A. Pyke, "Aetiological Factors in Diabetes," *Postgraduate Medical Journal 35* (1959): 261-65 and 286.

[24] Fitzgerald *et al.*, pp. 57-70.

Middleton and Caird sought to overcome some of the methodological shortcomings of earlier studies of the relationship between parity and diabetes by examining the records of 543 women and 413 men between the ages of 40 and 80 who represented virtually all newly diagnosed diabetics in a population whose age and sex structure was known.[25] For women they found an "excess" among the diabetics of women with four or more children. They also found that while the likelihood of diabetes increased with age, within each age group the rates also increased "with fair regularity with increasing parity." For men, the risk of diabetes was approximately that of women who had borne two children. In order to compare their data to those from earlier studies — including Pyke's and Fitzgerald's — the authors calculated the excess risk of diabetes for women at each parity level over that of the risk of nulliparous women. The results of their study were in close agreement with the other two as shown in Figure 10. They concluded that "between the ages of 50 and 80 years the excess risk, above that of a nullipara, is 20 per cent. for one child, 45 per cent. for two, 100 per cent. for three, 200 per cent. for four or five, and 400 per cent. for six or more children."

The National Health Examination Survey in the United States reported generally similar findings in a nationwide probability sample of residents between the ages of 18 and 79.[26] Using a standardized two-hour examination (including a modified glucose tolerance test), an interview, and medical and pregnancy history, it was found that there was an increase in the probability of diabetes in women with increasing parity, as shown in Figure 11. However, an additional study in Sudbury, Massachusetts, failed to confirm a clear association between large family size and diabetes for either men or women. The authors were therefore ultraconservative in their conclusions: "While prospective evidence is still lacking, available data seem to favor the con-

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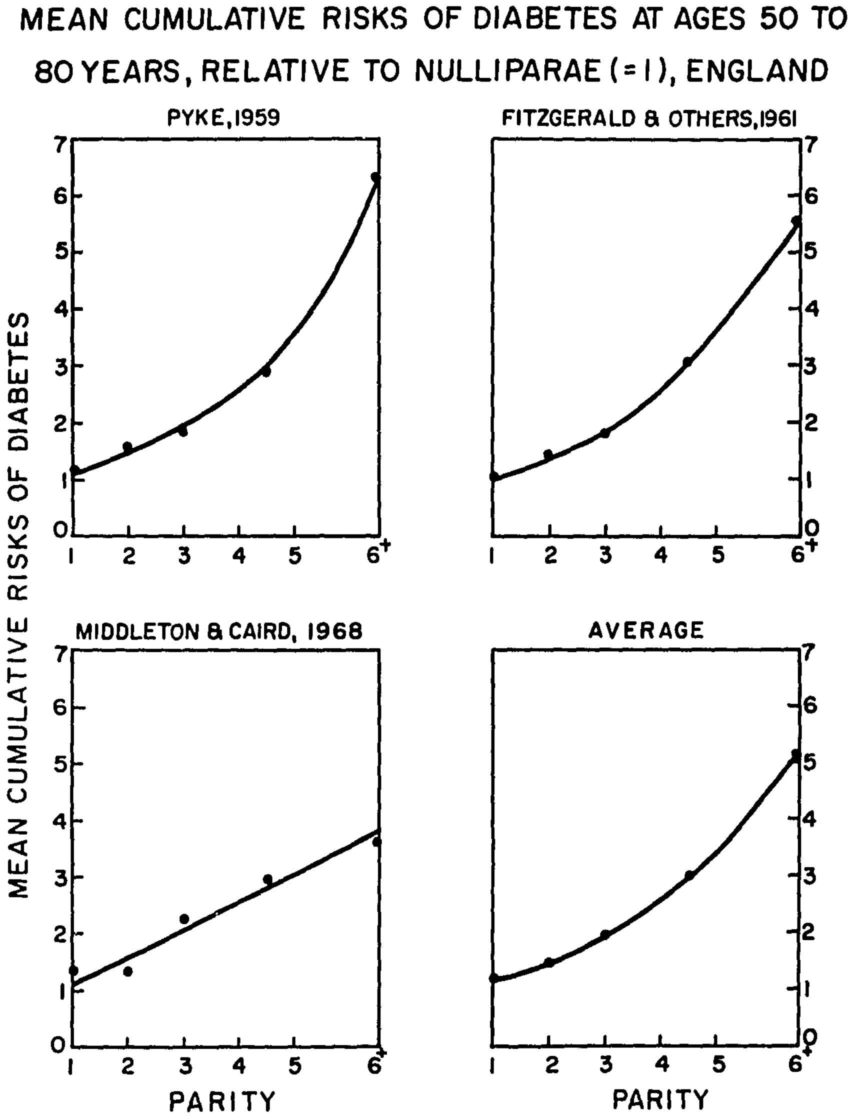
[25] G. D. Middleton and F. I. Caird, "Parity and Diabetes Mellitus," *British Journal of Preventive and Social Medicine* 22 (1968): 100-104.

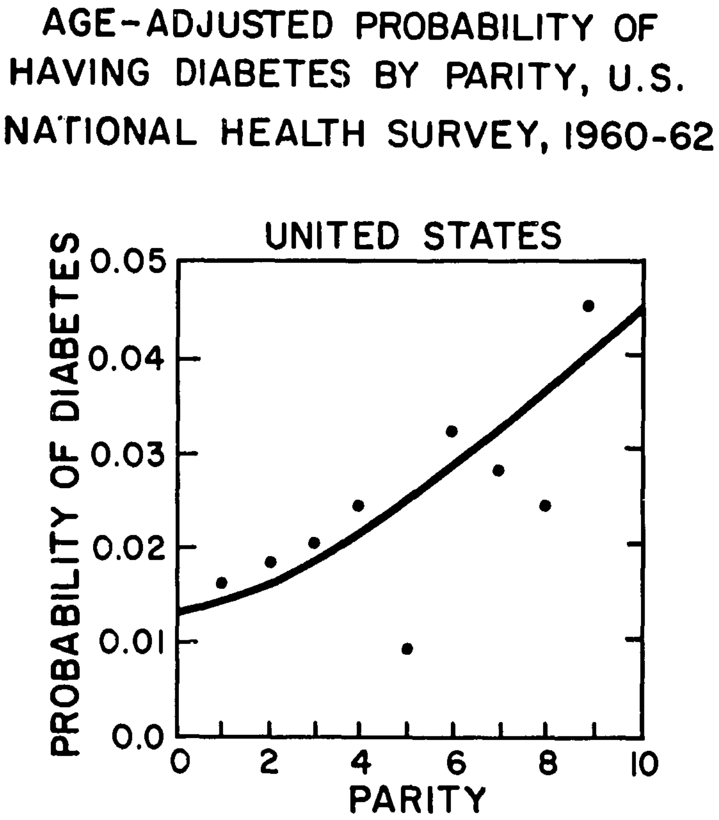
[26] John B. O'Sullivan and Tavia Gordon, "Childbearing and Diabetes Mellitus," *Vital and Health Statistics*, Series 11, Number 21 (1966).

Figure 10. Mean cumulative risks of diabetes at ages 50 to 80 years, relative to nulliparas (risk = 1) show close agreement among several British studies, all of which show an increase in risk with parity.



SOURCE: Drawn from data in G. D. Middleton and F. I. Caird, "Parity and Diabetes Mellitus," *British Journal of Preventive and Social Medicine* 22 (1968): 101.

Figure 11. The National Health Examination Survey, conducted in the United States between 1960 and 1962, found an increase in the probability of diabetes with increasing parity.



SOURCE: John B. O'Sullivan and Tavia Gordon, "Childbearing and Diabetes Mellitus," *Vital and Health Statistics*, Series 11, Number 21 (1966), p. 2.

clusion that pregnancy has no role in the causation or earlier appearance of diabetes. The Health Examination Survey, therefore, confirms the tendency toward higher parity among diabetic women without providing an explanation for it."[27]

CANCER OF THE CERVIX

A number of articles report an association between multiparity and cervical cancer and offer speculations on the reasons for the association.

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[27] *Ibid.*, p. 4.

In 1949, Maliphant reported that "In women of cancer age (35-64 years) the probability of the disease developing in any one year seems to range from 1 in 21,000 single women, through 1 in 6,500 in childless married women, to 1 in 1,500 in parous women."[28] Wynder and his associates speculated in their examination of environmental factors related to the development of cervical cancer that the association with high parity might be due to early marriage in these women.[29] Wahi, Mali, and Luthra venture a similar suggestion.[30] Although Logan reported a similar association between cervical cancer and marital and childbearing experience, he pointed out that no causal relationship had been established.[31] He also indicated that although married women who have children have a higher death rate from breast cancer during the childbearing years, once past the age of childbearing, single women and married women who have borne no children have a higher death rate from breast cancer. Some of these articles and others on environmental factors associated with cervical cancer are reviewed by Lundin, Erickson, and Sprunt.[32] In their own study of Memphis women, Lundin and his associates found that age at first pregnancy was highly correlated with cancer of the cervix. They also found a small positive association between high parity and intraepithelial carcinoma of the cervix in white women, but not in Negro women, and they found no consistent association for squamous cell carcinoma of the cervix.

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[28] R. G. Maliphant, "The Incidence of Cancer of the Uterine Cervix," *British Medical Journal 1* (1949): 978-82.

[29] Ernest L. Wynder, Jerome Cornfield, P. D. Schroff, and K. R. Doraiswami, "A Study of Environmental Factors in Carcinoma of the Cervix," *American Journal of Obstetrics and Gynecology 68* (1954): 1016-52.

[30] P. N. Wahi, Saraswati Mali, and Usha K. Luthra, "Factors Influencing Cancer of the Uterine Cervix in North India," *Cancer 23* (1969): 1221-32.

[31] W. P. D. Logan, "Marriage and Childbearing in Relation to Cancer of the Breast and Uterus," *The Lancet 265* (1953): 1199-1202.

[32] Frank E. Lundin, Jr., Cyrus C. Erickson, and Douglas H. Sprunt, *Socioeconomic Distribution of Cervical Cancer* (Public Health Monograph No. 73; Washington: Government Printing Office, 1964).

4

HEALTH ASPECTS OF BIRTH/PREGNANCY INTERVALS

Pregnancy constitutes an intense stress in any woman's life and may deplete her physical, mental, and emotional resources. The time interval between the termination of one pregnancy and the beginning of another is, therefore, a period of adjustment and rebuilding of those resources. An appreciable interval between births is generally accepted as beneficial to the health of mother and child; too short intervals (and in certain cases too long intervals as well) are believed to be associated with health hazards. However, an optimal interval between pregnancies is hard to define in precise terms, and as with other variables considered in this monograph, it is hard to separate completely the effects of birth interval from other variables such as maternal age, family size, and prenatal care.

Early studies conducted by the Children's Bureau in eight American cities during the period 1916-20 included investigations of many of the factors which were suspected of contributing to infant mortality; among these were maternal age, birth order, social class, and birth interval. It was found that short birth intervals increased the risk of infant mortality considerably. Data from two cities can be cited as examples. Among a sample of 1,135 births other than first births in Gary, Indiana, in 1916, the infant mortality rate was high (169.1 per 1,000 live births) when the birth in question occurred less than 15 months after a previous birth, and fell to a low (102.8 per 1,000) when the interval was 24 months or more.[1] Among 7,929 second and later births in Baltimore in 1915, Woodbury reported that the infant mortality rate was highest (146.7 per 1,000 live births) when the interval since the previous birth was less than two years, and dropped steadily to the mid-eighties per 1,000 live births when the interval was three or more years.[2] Even when other potentially influential factors such as maternal age, nationality, and birth order were taken into account, a birth interval effect remained apparent, and Woodbury concluded: "Evidently some factor that is intimately connected with the short interval — perhaps through the influence of frequent births upon the mother's health — affected adversely the chances of life of the infants who followed closely after preceding births."[3]

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[1] Elizabeth Hughes, "Infant Mortality: Results of a Field Study in Gary, Indiana, Based on Births in One Year," *Children's Bureau Publication*, No. 112 (1923).

Based on evidence gathered from obstetric cases at Johns Hopkins Hospital, Eastman was not convinced of the health hazards associated with a particular birth interval.[4] The "direct" part of Eastman's study was based on the case histories of 5,158 obstetric patients delivered at the hospital between 1936 and 1943 for whom the interval between the previous viable delivery and the termination of the pregnancy being studied was known and recorded. The "indirect" part of Eastman's study was based on 33,087 obstetric cases in which the interval was not recorded but was estimated from the known facts of maternal age and parity.

Eastman's analysis indicated that prematurity was the only condition that showed variation with the interval and then only among the "colored" patients; for the latter, prematurity occurred in 12.1 percent of patients with birth intervals less than 24 months, in 7.8 percent of those with intervals of 25-48 months, and in 9.6 percent of those with longer intervals. Neither stillbirths nor neonatal mortality varied significantly with the interval, and some conditions — notably hypertensive toxemia — increased with the length of the interval. Without going into a detailed discussion of the report, it is obvious (and was noted by Eastman himself) that the study sample was not representative of the population served by the hospital. Furthermore, the number of cases in the "direct" study population with "very brief" intervals of less than one year was too small — only 2.2 percent of the total.

In a detailed statistical analysis of more than seven million live and still births in the United States between 1937 and 1941, Yerushalmy examined the effects of birth interval as well as maternal age and parity on stillbirth rates.[5] Tabulations of the stillbirth rates according to maternal age and parity showed that the minimum rates occurred in different age groups for different parity levels. For example, the lowest stillbirth rates for second births occurred among women in the 20 to 24 age group; for third, fourth, and fifth births among mothers in the 25 to 29 age group; and so on up to the lowest rates for twelfth and higher order births among women between 40 and 44.[c] This apparent optimal relationship of certain maternal ages and parities seemed to indicate the operation of a birth interval effect, so Yerushalmy undertook a detailed analysis of the data.

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[2] Robert Morse Woodbury, "Causal Factors in Infant Mortality: A Statistical Study Based on Investigations in Eight Cities," *Children's Bureau Publication*, No. 142 (1925).

[3] *Ibid.*, p. 67.

[4] Nicholson J. Eastman, "The Effect of the Interval Between Births on Maternal and Fetal Outlook," *American Journal of Obstetrics and Gynecology* 47 (1944): 445-66.

[5] J. Yerushalmy, "On the Interval Between Successive Births and Its Effect on Survival of Infant—I. An Indirect Method of Study," *Human Biology* 17 (1945): 65-106.

The preliminary steps of the analysis, in which he calculated the theoretical effects of maternal age and parity on stillbirth rates, were summarized in Chapter 2. Having arrived at theoretical measures of the effects of these variables, he could then determine the "expected" stillbirth ratios for each parity and age group on the null hypothesis that the interval between births did not affect the stillbirth rate. A comparison of these "expected" ratios and the observed ratios gives an indication of the effect of birth interval.

The observed relative stillbirth ratios for each parity level were plotted according to maternal age as shown in Figure 12; the dotted line represents the theoretical stillbirth ratio according to maternal age when birth order effects are eliminated. If birth interval did *not* affect stillbirth rates, it would be expected that the curves representing the observed ratios for each parity level would be parallel to the theoretical curve, but this is obviously not the case. In analyzing the graph in Figure 12, keep in mind that as the parity level rises within each age group, it can be assumed that in general the interval between births becomes longer. Thus, examining the left half of the graph showing stillbirths among the infants of mothers under 30, it can be seen that the stillbirth ratios are higher for the high parity levels, thus indicating a detrimental effect of increasingly shorter intervals with rising parity. For example, the stillbirth ratio for women under 20 who have had six infants is nearly three times as high as for those who have had only two. For women between 20 and 25, the ratio for those who have had eight births is more than three times as great as for those who have had only two births.

The right half of the graph, showing stillbirth rates among mothers over 30, shows a considerable decrease in the stillbirth ratio for high birth orders — indicating the salutary effect of moderate birth intervals — while there is a sharp increase in stillbirths for the low birth orders, indicating the detrimental effect of long birth intervals. Thus,

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[c] Howard B. Newcombe reported similar findings in "Environmental Versus Genetic Interpretations of Birth-Order Effects," *Eugenics Quarterly* 12 (1965): 98.

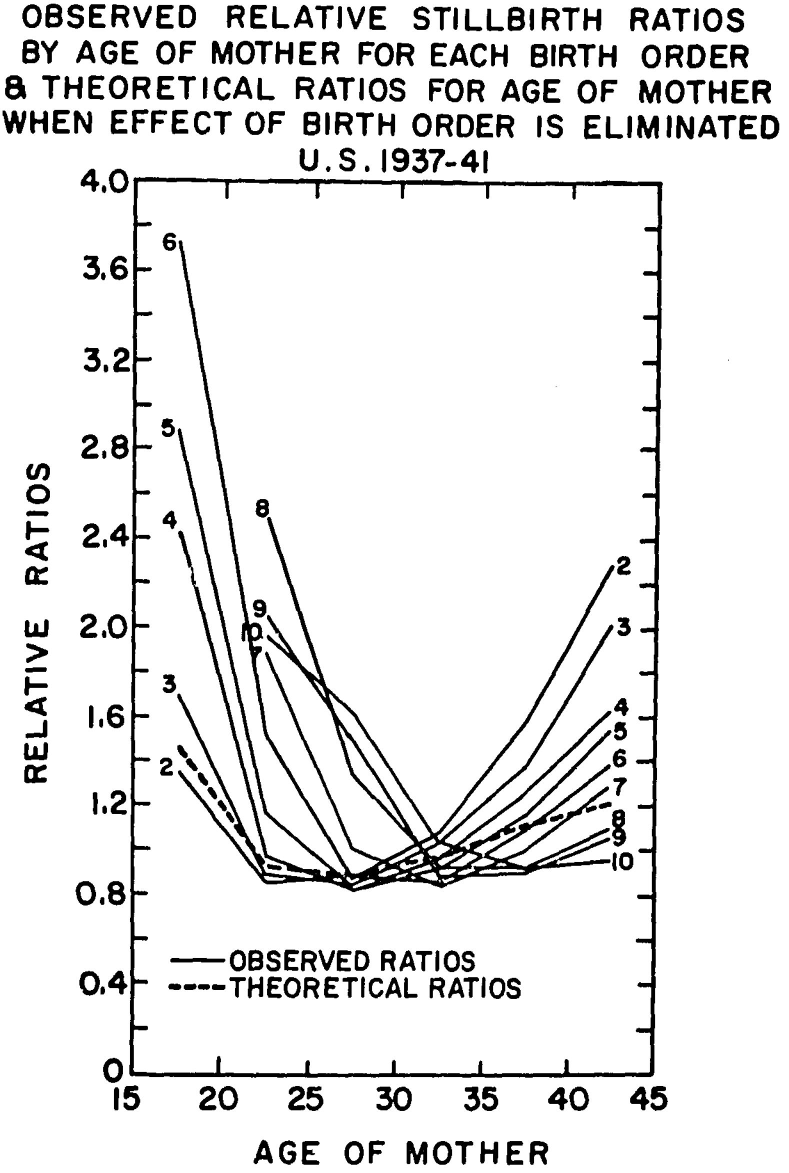

Figure 12. Observed relative stillbirth ratios by age of mother for each birth order compared with theoretical ratios for age of mother when effect of birth order is eliminated show probable birth interval effect for births to all multiparas between 15 and 44 years of age in the United States from 1937 to 1941.

SOURCE: J. Yerushalmy, "On the Interval Between Successive Births and Its Effect on Survival of Infant—I. An Indirect Method of Study," *Human Biology 17* (1945): Figure 7, p. 93; reprinted by permission of Dr. Yerushalmy.

although Yerushalmy acknowledged the need for studies which are based on exact knowledge of birth intervals — rather than on an averaging assumption as his were — in order to arrive at a "quantitative expression of the exact optimum interval," he concluded that his analysis "demonstrates that relatively short intervals and relatively long intervals are associated with higher stillbirth rates while the moderate intervals lead to the lowest rates."

Another study by Yerushalmy and his co-workers was based on an analysis of the reproductive histories of all the women under 50 on the island of Kauai, Hawaii, who had had at least one pregnancy.[7] For these studies the interval between the end of one pregnancy and the beginning of the next was known. The findings on fetal deaths supported Yerushalmy's previous hypothesis that intervals that were too long or too short could be detrimental. When the interval between pregnancies was less than four months, fetal, infant, and childhood mortality were all higher than for longer intervals. (See Figure 13.) For fetal deaths at less than 20 weeks gestation, an interval of one year seemed to carry the least risk; for later fetal death and neonatal death, the rates were lowest for intervals between one and three years, and rose again slightly when the interval exceeded three years. For infant and childhood mortality, the rates dropped steadily with increasing birth intervals.

Bishop and Douglas have both reported on the association between birth intervals and prematurity. In a nationwide British study of more than 13,000 births during a one-week period in 1946, Douglas found that the percent of premature infants was highest for infants born after an interval of one year or less since the previous birth and that the percentage was lowest for those born after an interval of at least two but less than six years, as shown in Figure 14.[8] In his study in Philadelphia based on 16,000 consecutive deliveries, Bishop reported that the incidence of premature births was high when the interval between pregnancies was less than one year.[9]

An extensive study of problems of infancy has been undertaken by the Perinatal Research Branch of the National Institute of Neurological Diseases and Stroke in collaboration with fourteen American medical

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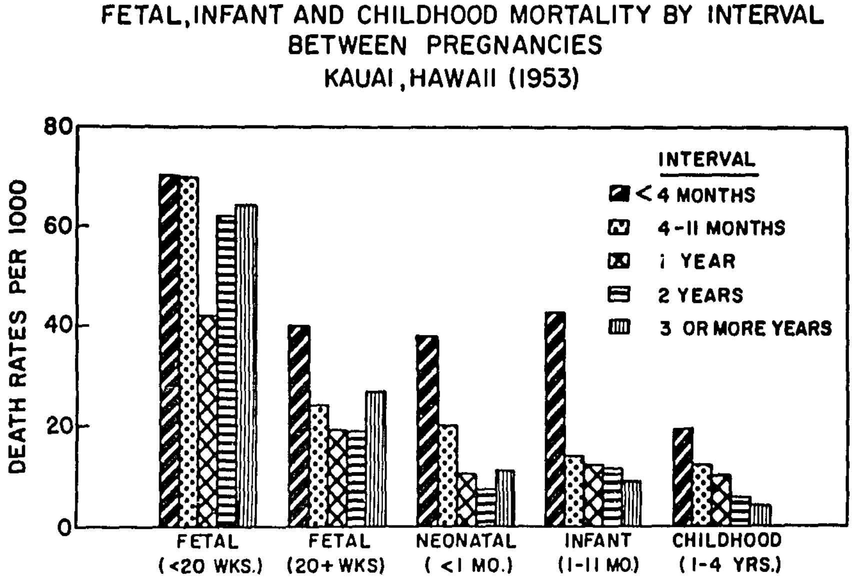
[7] J. Yerushalmy, Jessie M. Bierman, Dorothy H. Kemp, Angie Connor, and Fern E. French, "Longitudinal Studies of Pregnancy on the Island of Kauai, Territory of Hawaii—I. Analysis of Previous Reproductive History," *American Journal of Obstetrics and Gynecology 71* (1956): 80-96.

[8] J. W. B. Douglas, "Some Factors Associated with Prematurity: The Results of a National Survey," *Journal of Obstetrics and Gynaecology of the British Empire 57* (1950): 143-70.

[9] Edward H. Bishop, "Prematurity: Etiology and Management," *Postgraduate Medicine 35* (1964): 185-88.

Figure 13. Fetal, infant, and childhood mortality rates by interval between pregnancies for women under 30 on the Island of Kauai, Territory of Hawaii (1953) show the effect of various intervals. Rates were calculated as follows: fetal deaths under 20 weeks per 1,000 total pregnancies; fetal deaths over 20 weeks per 1,000 pregnancies of 20 or more weeks; neonatal deaths per 1,000 live births; infant deaths per 1,000 infants surviving the first month of life; and childhood deaths per 1,000 children surviving the first year of life.



SOURCE: Drawn from data in Yerushalmy *et al.*, "Longitudinal Studies of Pregnancy on the Island of Kauai, Territory of Hawaii—I. Analysis of Previous Reproductive History," *American Journal of Obstetrics and Gynecology 71* (1956): Table V, p. 90.

centers. To make a preliminary analysis of the effects of short birth intervals, infants born after intervals of less than a year since their next oldest sibling were matched according to sex, race, and socioeconomic status with infants born after longer intervals (24-60 months); a total of 251 matched pairs were studied.[10] As shown in Table 11, the infants born after short intervals fared less well on nearly all the standard measures than those born after long intervals; that is, "The children with short intersib intervals had lower birth weight, lower Bayley

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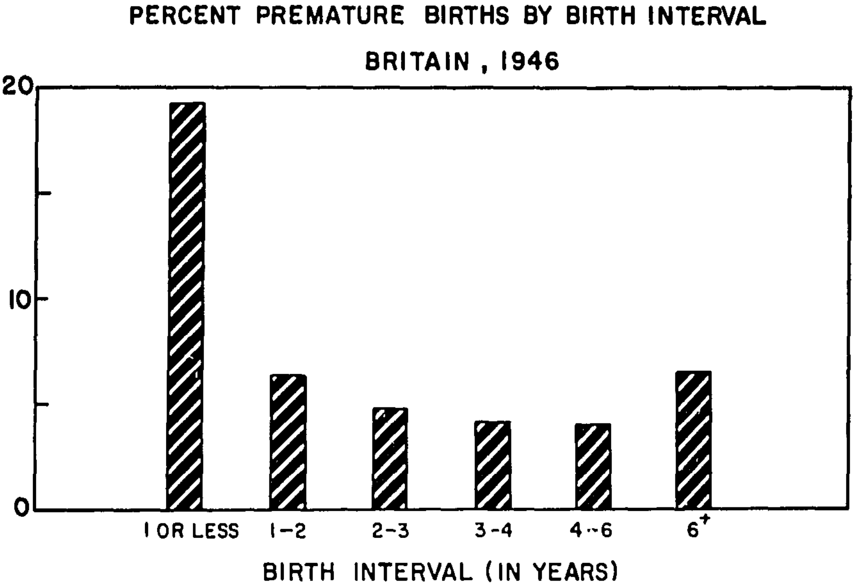
[10] W. L. Holley, A. L. Rosenbaum, and J. A. Churchill, "Effect of Rapid Succession of Pregnancy," in *Perinatal Factors Affecting Human Development* (Scientific Publication No. 185; Washington: Pan American Health Organization, 1969), pp. 41-44.

Figure 14. Percent of premature births by interval since preceding birth for infants born in Britain during one week of 1946, shows the probable advantage of intervals of two to six years.



SOURCE: Drawn from data in J. W. B. Douglas, "Some Factors Associated with Prematurity: The Results of a National Survey," *Journal of Obstetrics and Gynaecology* 57 (1950): Table XI, p. 155.

developmental scores at eight months of age, lower Binet IQ scores at four years of age, and a greater incidence of neurologically suspicious or abnormal outcome at one year of age."

One of the very few studies conducted in developing communities which investigated the effects of different birth intervals is the Khanna Study.[11] Children in a group of 1,479 births in eleven Punjab villages were followed as cohorts by monthly visits until they died or had survived the second year of life. Judging from the study findings, as shown in Figure 15, birth interval seems to exert the greatest influence on mortality during the first year of life; rates for both neonatal and infant mortality (up to one year of age) were high for infants born less than two years after a previous birth; the mortality rates declined as birth intervals became progressively longer than two years. For mortality in

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[11] John B. Wyon and John E. Gordon, "A Long-Term Prospective-Type Field Study of Population Dynamics in the Punjab, India," in Clyde V. Kiser, ed., *Research in Family Planning* (Princeton, N.J.: Princeton Univ. Press, 1962), pp. 17-32.

TABLE 11

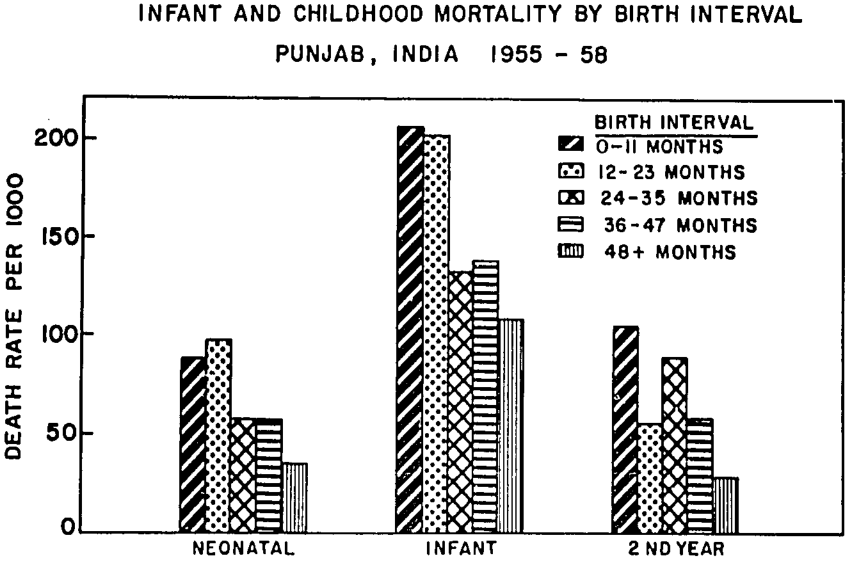
Developmental Measures in Children Born After an Interval of Less Than One Year (R) Compared to Those Born Two to Five Years After Previous Full-Term Pregnancy (C)

Case pairs	Pregnancy (weeks)		Birth weight (kilograms)		Bayley Mental Scale		Bayley Motor Scale		Binet IQ	
	C	R	C	R	C	R	C	R	C	R
White										
Means	40.1	40.2	3.45	3.28	81.0	79.6	33.2	31.7	105.4	99.4
Number	92		93		84		84		93	
Significance (*p*)	N.S.		$<.05$		N.S.		$<.05$		$<.005$	
Negro										
Means	39.5	39.1	3.25	3.08	79.1	77.6	33.9	31.4	93.7	89.3
Number	152		158		112		111		158	
Significance (*p*)	N.S.		$<.005$		$<.05$		$<.001$		$<.005$	
All means	39.7	39.5	3.32	3.15	79.9	78.5	33.6	31.5	98.0	93.0
Number	244		251		196		195		251	
Significance (*p*)	N.S.		$<.001$		$<.01$		$<.001$		$<.001$	

NOTE: C = controls; R = rapid-succession cases. The test used was the *t*-test.

SOURCE: W. L. Holley, A. L. Rosenbaum, and J. A. Churchill, "Effect of Rapid Succession of Pregnancy," in ***Perinatal Factors Affecting Human Development*** (Scientific Publication No. 185; Washington: Pan American Health Organization, 1969), p. 42.

Figure 15. Infant and early childhood mortality among 1,479 children born in 11 Punjab villages between 1955 and 1958 is shown by interval since preceding birth. Rates were calculated as follows: neonatal deaths per 1,000 infants under 28 days; infant deaths per 1,000 infants under one year of age; and second year deaths per 1,000 population.



SOURCE: Drawn from data in John B. Wyon and John E. Gordon, "A Long-Term Prospective-Type Field Study of Population Dynamics in the Punjab, India," in Clyde V. Kiser, ed., *Research in Family Planning* (Princeton, N.J.: Princeton Univ. Press, 1962), Table 2, p. 25.

the second year of life, the rate was highest for infants born after an interval of less than one year; the next highest rate was for those born after an interval of two to three years; the rates for those born after intervals of more than four years were the lowest.

Working in Candelaria, Colombia, Wray and Aguirre studied the association of a number of social and demographic factors with protein-calorie malnutrition (PCM) in preschool children.[12] For 489 children of the 1,094 under the age of six, they had data on the interval between the study child and the next youngest living sibling. Nearly three-fourths of these children had a sibling less than two years younger; about 40 percent of these children were malnourished. Nearly 53 percent of those who had a sibling two to three years younger were malnourished; only when the interval between the children was more than three years did the percentage of those malnourished drop to about 27 percent. Thus, the authors concluded that "The difference in malnutrition when we compare all the children with an interval of less than 36 months with those with a longer interval is of a low order of significance ($P = 0.065$), but the percentages clearly suggest that an interval of at least three years between children in this community 'protects' the older child, to some extent from malnutrition."[13]

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[12] Joe D. Wray and Alfredo Aguirre, "Protein-Caloric Malnutrition in Candelaria, Colombia—I. Prevalence; Social and Demographic Causal Factors," *Journal of Tropical Pediatrics* 15 (1969): 76-98.

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[13] *Ibid.*, p. 92.

5

FAMILY PLANNING VARIABLES AND FAMILY HEALTH AND ADJUSTMENT

The studies reviewed in this chapter concern aspects of family health — including mental health and emotional adjustment — which have not been considered in earlier chapters. Once again it must be indicated that we are dealing with a complicated problem in examining the relationship of family planning variables to health and adjustment. What must be examined is a whole complex of social, demographic, and epidemiologic conditions; the interrelationship of some of these factors is indicated by Chen and Cobb in a series of graphs which show increasing family size, for example, with lower income of father, lower level of educational achievement of both parents, and lower rank of occupational achievement by the father — all of which could contribute to poor family health.[1]

Although the variables of maternal age and childspacing are considered briefly, the most important of the family planning variables which has been studied in relation to family health is size of the family. The study of family size as an independent variable in family health and well-being is essentially a study in the pathology of crowding, with the underlying hypothesis that the larger the family, the higher the probability of poor physical, mental, and emotional health in both parents and children. The literature on this subject is voluminous, but the evidence is sometimes equivocal or controversial; generally speaking, the evidence on the association between family size and morbidity in family members is less definitive than that on the association between family size and fetal and infant mortality. However, considered collectively, the literature is weighted in the direction of the existence of an association between increased family size and an increase in family health problems.

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[1] Edith Chen and Sidney Cobb, "Family Structure in Relation to Health and Disease: A Review of the Literature," *Journal of Chronic Diseases* 12 (1960): 544-67.

A variety of indicators from studies conducted in diverse geographical and cultural settings can be cited to illustrate an association between increased family size and increased morbidity in family members. Some health problems — malnutrition, for example — are probably directly related to the increased strain on family resources with each additional child; in the case of common infections, larger family size may simply lead to more frequent exposure of family members to infection. Among the health indicators dealt with separately in this chapter are handicapping conditions, malnutrition, infection, dental health, family adjustment, and mental health.

HANDICAPPING CONDITIONS

Although mortality in the post-neonatal period from congenital malformations did not show much variation with birth order or social class in England for 1949-50,[2] there are a number of reports that the incidence of handicapping conditions does vary with maternal age and birth order. There may be a fallacy in the cause-of-death assigned to many children with congenital handicaps; for example, the primary cause of death may be listed as pneumonia, and unless a complete record of an underlying handicapping condition is available, it can easily be missed. However, more important in terms of the family and community burden from handicapping conditions is the survival rather than death during infancy of children with severe physical and/or mental handicaps.

Among the most important studies of the relationship between maternal age and birth order and handicapping conditions in children are those by Newcombe, two of which are reviewed here. The first study by Newcombe, in the province of British Columbia in Canada, involved matching nearly 5,000 records of handicapping conditions with birth records for children born between 1953 and 1958.[3] The total birth population of the province for the same period (approximately 213,000) was used as control. In this study to try to measure maternal age and birth order effects, Newcombe analyzed the pooled data for all handicaps registered, and analyzed individually the data for each of eight broad categories of disease.[4] In the second study, by Newcombe and Tavendale, the same records were analyzed for eighteen different conditions as were, in addition, records for about 2,400 stillbirths for 1953-58 and for nearly 6,500 infant deaths for 1953-59.[5] In general, these analyses showed a high risk for the infants of "young" (under 20) and "old" (over 35) mothers and for those of first birth order or of high birth orders. The risks were accentuated by "unusual" combinations such as high order births to young mothers or first order births to old mothers. More specific findings on the conditions associated with each of these groups are summarized in Table 12.

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[2] See the summary of reports by Morris and Heady in Chapter 2.

[3] Howard B. Newcombe, "Screening for Effects of Maternal Age and Birth Order in a Register of Handicapped Children," *Annals of Human Genetics* 27 (1964): 367-82.

The results of greatest statistical significance were recorded for mental and related disorders in the offspring of older mothers, due to the inclusion of mongolism (Down's syndrome) in this category. The authors explain that this association results from a high rate of chromosomal mutations due to non-disjunction in the ova of older mothers. Newcombe also suggests that many of the risks associated primarily with birth order, particularly infective diseases in high birth order children, may be environmental in origin. Although it is impossible to draw definitive conclusions on the etiology of most of the other handicapping conditions from these data, they do provide a strong cautionary sign for the high risk groups.

Comparable results in regard to Down's syndrome had been reported earlier for a retrospective British study by Smith and Record.[6] The study sample comprised 217 of the 252 mongols born in Birmingham in the years 1942-52, whose mothers could be traced and interviewed. The study children were compared with 1,156 infants representative of all births in Birmingham for the same period. The incidence of mongols per 1,000 related births rose from 0.31 for mothers under 25 years of age to 2.15 for those 35-39, to 7.27 for those 40-44, to 9.99 for those 45-49. Similarly, the incidence rose from 0.77 for first born and 0.67 for second born up to 2.07 for fifth and later births. The relationship with maternal age was "little affected by eliminating the influence of birth rank" although the relationship with birth order was eliminated when maternal age was fixed. However, the incidence was "greater for first born than in later born infants at all maternal ages except '40 and over.' "

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[4] These eight categories of disease were: (1) Infective and parasitic diseases; (2) neoplasms; (3) allergic, endocrine system, metabolic, and nutritional disease; (4) mental, psychoneurotic, and personality disorders; (5) diseases of the nervous system and sense organs; (6) diseases of the bones and organs of movement; (7) congenital malformations; (8) certain diseases of early infancy.

[5] Howard B. Newcombe and Olwyn G. Tavendale, "Maternal Age and Birth Order Correlations: Problems of Distinguishing Mutational from Environmental Components," *Mutation Research 1* (1964): 446-67.

[6] Alwyn Smith and R. G. Record, "Maternal Age and Birth Rank in the Aetiology of Mongolism," *British Journal of Preventive and Social Medicine* 9 (1955): 51-55.

The findings on the association between advancing maternal age and the risk of Down's syndrome were also confirmed by an American study by Stark and Mantel, who investigated maternal age and birth order for 2,432 "mongoloids" born in Michigan between 1950 and 1964 and for 706 leukemia deaths among children born in Michigan during the same period.[7] The authors found that the risk of childhood leukemia also increased with maternal age, but that it decreased as birth order increased.

In a huge World Health Organization–sponsored collaborative study of congenital malformations in series of consecutive births in 24 medical centers in 16 countries, a number of variables were considered, including birth order and maternal age. Unfortunately, tabulations of malformation by birth order were not provided in the voluminous 1966 report by Stevenson and associates.[8] In regard to maternal age, however, despite inter-center variations, the traditional association with Down's syndrome was confirmed. It was found that just over 50 percent of the 347 cases of Down's syndrome identified were born to mothers over 35 years of age, although mothers of this age constituted less than 11 percent of all those studied. The incidence of Down's syndrome per 100,000 total single births to mothers in various age groups was as follows:

Age	*Incidence per 100,000*
Under 15 years	30
15-19	50
20-24	32
25-29	38
30-34	163
35-39	211
40-44	634
45+	1,665

MALNUTRITION

Malnutrition is one of the most important health problems, for it is one of the truly international problems, taking a toll not only in the

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[7] Charles R. Stark and Nathan Mantel, "Effects of Maternal Age and Birth Order on the Risk of Mongolism and Leukemia," *Journal of the National Cancer Institute* 37 (1966): 687-98.

[8] Alan C. Stevenson, Harold A. Johnston, M. I. Patricia Stewart, and Douglas R. Golding, "Congenital Malformations," *World Health Organization Bulletin 34* (1966).

TABLE 12

Children with Special Risk of Handicapping Conditions

High risk group	Broad category of disease (Newcombe)	Specific disease categories (Newcombe and Tavendale)
First-born offspring	Diseases of early infancy	Clubfoot Intracranial and spinal injuries at birth
Higher birth order offspring	Infective and parasitic diseases	
Order 3 onwards	Mental disorders Diseases of the nervous system and sense organs	Mental deficiency, mongolism, strabismus
Order 4 onwards		Other congenital malformations of the nervous system and sense organs Postnatal asphyxia and atelectasis
Order 5 onwards		Cleft palate and harelip

Offspring of very young mothers	"Other" — including diseases of skin and cellular tissue, digestive system, and blood and blood-forming organs Possibly, diseases of the nervous system and sense organs and congenital malformations	Intracranial and spinal injury at birth Postnatal asphyxia and atelectasis Clubfoot
Offspring of older mothers	Mental disorders	Mental deficiency including mongolism Mongolism alone Cerebral spastic infantile paralysis Congenital malformations of the circulatory system Intracranial and spinal injury at birth Postnatal asphyxia and atelectasis

SOURCES: Prepared from data in Howard B. Newcombe, "Screening for Effects of Maternal Age and Birth Order in a Register of Handicapped Children," *Annals of Human Genetics* 27 (1964): 367-82 and Howard B. Newcombe and Olwyn G. Tavendale, "Maternal Age and Birth Order Correlations: Problems of Distinguishing Mutational from Environmental Components," *Mutation Research* 1 (1964): 446-67.

crowded streets of Calcutta and small villages of Latin America, but in the Mississippi delta of the United States as well. Furthermore, the quality of nutrition is decisive in determining the quality of a family's health, affecting everything from children's growth and development to family members' dental health and resistance to infection.

One important study that sought to examine demographic and social factors in the causation of malnutrition was that by Wray and Aguirre in Candelaria, Colombia.[9] The total population of the town was included in the survey of protein-calorie malnutrition among preschool children; that is, 505 families with 1,094 children under the age of six. Complete socioeconomic data as well as measures of malnutrition were obtained from a random sample among the villagers of 354 families with 721 of the preschool children. The difference in the prevalence of malnutrition in children from families with four living children or fewer (38 percent malnourished among 642 children) compared with those from families with five or more (44 percent among 426 children) was statistically significant. A similar effect was found for maternal age. Unfortunately, the authors used two broad classifications, younger mothers (those under 35 years) and older mothers (those 35 and over). The prevalence of malnutrition was 38.4 percent in children of younger mothers and 51.7 percent in those of older mothers. Although the difference was statistically significant, a further breakdown of at least the younger group would have been more informative. Another finding of interest in the study was that when the detailed economic and demographic data were correlated with the presence of malnutrition among preschool children, it was found, not surprisingly, that the pesos per person per week spent on food decreased steadily with increasing family size.

That poor nutrition is associated with large family size in "developed" as well as in "underdeveloped" nations is shown in a report by Hubble, who found that the incidence of iron-deficiency anemia in Britain showed "a positive correlation with the size of the family."[10] He also reported that the British National Food Survey of 1962 showed that regardless of social class, "families with four or more children had diets which on average contained less calcium (too little milk), less protein (too little meat and fish) and less energy value (inadequate total calorie intake) than the standards recommended by the British Medical Association."

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[9] Joe D. Wray and Alfredo Aguirre, "Protein-Calorie Malnutrition in Candelaria, Colombia: I. Prevalence; Social and Demographic Causal Factors," *Journal of Tropical Pediatrics 15* (1969): 76-98.

[10] D. Hubble, "Physical Health and Family Planning—I. (b) Physical Hazards of Uncontrolled Fertility for the Child," *Preventive Medicine and Family Planning: Proceedings of the Fifth Conference of the Europe and Near East Region of the International Planned Parenthood Federation* (Copenhagen, 1966).

A study by Robertson and Kemp on the "coloured" population of Cape Town, South Africa, resulted in the conclusion that large family size *per se* did not put families at risk of malnutrition, but that poverty and poor parental care did.[11] This study also confirmed the belief that poorly nourished children die of diseases of malnutrition and of gastroenteritis and broncho-pneumonia more frequently than well-nourished, well-developed children. Finally, it was found that generally whole families were at risk of suffering malnutrition (not just laterborn children) and that this was the case "whether there are 3 children or 10."

INFECTION

There is evidence of an increase in the risk of infection with increasing family size, perhaps even independent of a family's nutritional status. In a longitudinal study of Cleveland families, Dingle and associates found an increasing incidence per person-year and per family-year of common respiratory diseases and infectious gastroenteritis with increasing family size.[12] The increase in gastroenteritis is shown in Figure 16. This increase seemed to be attributable to the greater likelihood of direct exposure of family members to infection. These findings were confirmed by two extensive British studies. In the study of a thousand Newcastle families, Spence and his associates found an increase in severe respiratory infections in infants in poor and "overcrowded" families,[13] while Douglas and Blomfield found that the risk of respiratory infections was greater in families in which some members had chronic colds and in those with school children who were likely to bring infections into the home.[14]

DENTAL PROBLEMS

An example of the way in which family size may have a different effect under different circumstances at different times may be shown

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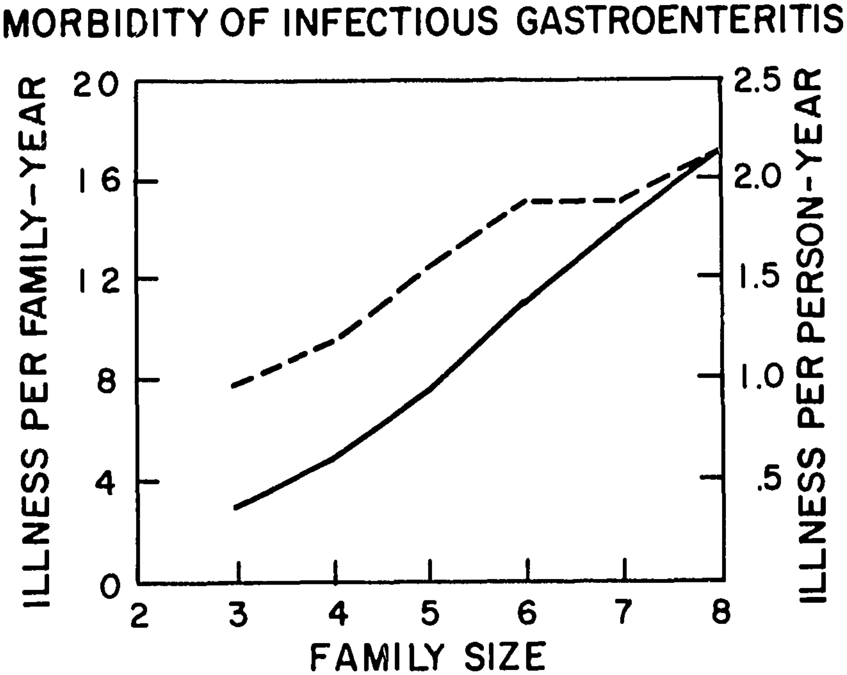
[11] Isobel Robertson and Margretha Kemp, "Child Health and Family Size: A Survey Relating to the Cape Coloured Population of Cape Town in the Years 1961-1962," *South African Medical Journal 37* (1963): 888-93.

[12] John H. Dingle, George F. Badger, and William S. Jordan, *Illness in the Home: A Study of 25,000 Illnesses in a Group of Cleveland Families* (Cleveland: Press of Western Reserve University, 1964), pp. 39-40, 193, and 338.

[13] James Spence, W. S. Walton, F. J. W. Miller, and S. D. M. Court, *A Thousand Families in Newcastle Upon Tyne: An Approach to the Study of Health and Illness in Children* (London: Oxford Univ. Press, 1954), pp. 61-62.

[14] J. W. B. Douglas and J. M. Blomfield, *Children Under Five: The Results of a National Survey* (London: George Allen & Unwin, 1958), p. 72.

Figure 16. The solid line in the graph shows the increase in morbidity of infectious gastroenteritis per family-year with increasing family size; the dotted line shows the increase per person-year.



SOURCE: Drawn from data in John H. Dingle, George F. Badger, and William S. Jordan, *Illness in the Home: A Study of 25,000 Illnesses in a Group of Cleveland Families* (Cleveland: Press of Western Reserve University, 1964), p. 193.

by studies of family size in relation to dental problems. In a secondary analysis of data from a statewide dental health survey in North Carolina, Omran and Beck found a higher rate of dental problems in large families than in small families.[15] These findings are in accord with several pre-World War II studies in Britain which are discussed by Mansbridge.[16] However, Mansbridge's findings in a post-war study are exactly the opposite: that is, he found a higher rate of decayed, missing, and filled teeth in only children than in third or later children, for both boys and girls, for deciduous and permanent teeth. In discussing these contradictory results, Mansbridge asserts that diet plays a large part in dental health. He postulates that in large families with poor diets that fall well below the level needed for minimally adequate nutrition, large numbers of dental health problems will be evident, as was the case in pre-World War II England. As living standards in England improved after the war and as children began to receive milk and other essential nutrition at school, the general level of nutrition was raised, so that even children in large families had adequate nutrition, but did not consume as much of the decay-promoting foods, such as sweets, that only children had access to.

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[15] A. R. Omran and J. Beck, "Dental Problems and Family Size in North Carolina" (unpublished).

[16] J. N. Mansbridge, "The Influence of Family Size on the Prevalence of Dental Caries in Children," *Archives of Oral Biology* 2 (1960): 209-14.

MULTIPLE INDICATORS

In an attempt to measure the relationship between family size and overall health of family members, Hare and Shaw gathered information on several indices of health (including mental health) for 499 urban families.[17] The indices included the number of the subject's consultations with physicians (from physicians' records), the subject's evaluation of his own general health and the extent to which his activities had been restricted by health problems (from an interview), and a measure of his mental health (from interviews or practitioners' diagnoses). The investigators found that for parents — particularly mothers — there was an association between poor health and large family size, as indicated in Table 13. For children, no notable differences in health status could be found among families with one to three children, but in families with four or more there were fewer apparent health problems and behavior disorders than in the smaller families. The authors speculate that this apparent better health for children in large families indicates few visits to the doctor and poor maternal memory of childhood illness in large families rather than actual better health.

MENTAL ILLNESS

The correlation of mental illness with family size offers another area for investigation — and great controversy. Although concepts of and attitudes toward physical health are culturally controlled to a large extent, this is even more decidedly the case for mental health and illness. Most of the studies dealt with here are from western cultures and insofar as their results are valid, they are valid for western cultures only. This is underlined by findings from Asia on family size and schizophrenia that are directly contradictory to western results. A

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[17] E. H. Hare and G. K. Shaw, "A Study in Family Health: (1) Health in Relation to Family Size," *British Journal of Psychiatry 111* (1965): 461-66.

TABLE 13

Health of Parents, by Family Size

	Fathers					Mothers				
	Family size					Family size				
	1	2	3	4+	p<	1	2	3	4+	p<
	%	%	%	%		%	%	%	%	
Consultations, at least one	50	58	53	70	.01	53	58	70	73	.01
Consultations, 4 or more	21	23	25	30		23	20	28	32	
General health, fair or poor	20	16	13	20		20	18	27	32	.05
Days limited, one or more	8	11	16	14	.05	15	14	21	23	.05
Conditions, one or more	57	50	54	60		67	66	61	73	
Neurosis (general practitioner)	(2)	6	6	(3)		10	11	13	18	
Neurosis (interview)	4	4	4	3		9	12	11	21	.05
Fatigue	7	4	7	(8)		8	15	15	18	.05
High neuroticism (score 7-12)	33	26	30	34		38	39	41	49	
Introversion (score 0-6)	41	42	40	51		49	47	43	56	

NOTE: Rates in parentheses are based on fewer than five cases.

SOURCE: E. H. Hare and G. K. Shaw, "A Study in Family Health: (1) Health in Relation to Family Size," *British Journal of Psychiatry 111* (1965): Table II, p. 463; reprinted by permission of Drs. Hare and Shaw.

further weakness is that many of the studies which show a correlation between mental illness and large family size are case history studies which are liable to many methodological defects. However, for the sake of completeness the evidence they present is worth examining.

One impressive paper on family size and mental illness was written by Gregory in 1958.[18] In this paper, Gregory detailed the shortcomings of previous statistical analyses of the relationship of family size to mental illness; in his own analysis of previously reported data, he tried to correct these shortcomings. The data Gregory analyzed were those reported by Norton and those reported by Malzberg. Norton's studies were based on 500 patients at least 15 years of age selected randomly from among the patients of the psychiatric department of a general hospital in London between 1947 and 1948. Controls were 500 physically ill patients in the hospital who were matched with the psychiatric subjects for age, sex, and to some extent for social class. Information on an additional 2,000 patients in the same department was obtained from their records for the period 1943-47. Malzberg studied 549 patients after their first hospital admission with *dementia praecox* and 498 after first admission with manic-depressive psychoses. He selected his subjects in the order of their admission to Manhattan State Hospital between 1930 and 1935, excluding only those for whom information was insufficient for analysis and those who were illegitimate or who had half-siblings.

Considering mean family size alone, Gregory found no striking differences between either the psychiatric patients or the controls and the general populations from which the samples were drawn. For Norton's psychiatric patients and controls, the frequency of only children was unusually high, however. Among the manic-depressives in Malzberg's study, mean family size was slightly higher than for those with *dementia praecox* and for the general population. When ordinal position was examined in relation to family size, Gregory found that in families of four or more, there was an excess of observed over expected incidence of mental illness in youngest children, particularly in Malzberg's samples.

It is very likely that a number of the other studies reported here suffer from the kind of bias Gregory deplores, for most of them are not adjusted for the frequency distribution of family sizes in the general population. However, their findings will be reported briefly.

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[18] Ian Gregory, "An Analysis of Familial Data on Psychiatric Patients: Parental Age, Family Size, Birth Order, and Ordinal Position," *British Journal of Preventive and Social Medicine 12* (1958): 42-59.

Wahl reviewed United States Navy case histories of 568 male schizophrenics and found that the average family size of the schizophrenic sample was 4.4 children per family as compared with the national average of 2.2 children per family.[19] In their study of the records of 1,000 schizophrenics in Pennsylvania, Barry and Barry report that "in large families the second half of the sibships were overrepresented; in small families firstborn men were significantly more numerous than lastborn."[20] The authors point out that these findings are in accord with those of other investigators in western countries, but that exactly the opposite results have been reported for Asian countries, where the early birth positions in large families are overrepresented. Erlenmeyer-Kimling challenges the conclusion that birth order and the development of schizophrenia can be shown to be related.[21]

Many attempts have been made to link family size and/or birth order with other mental health problems such as alcoholism, but the results of these studies are generally negative or even less conclusive than those on schizophrenia. Among the negative findings on large family size and mental illness are those of Smith and McIntyre, who conclude that there is no significant difference in mean family size between the mentally ill and controls and no significant overrepresentation of last children in large families among the mentally ill.[22] Nor did Stein find any association between psychiatric problems and such family characteristics as size, class, or family history of mental illness in her study of 1,800 patients who represented a 20-percent sample of one group practice in London.[23]

Thus the evidence on family size and mental illness is inconclusive at best, and the most one can hope for is more conclusive evidence from additional studies; as Gregory says, "further investigations of such variables as parental age, family size, birth order and ordinal position are indicated, and may well yield profitable information."[24]

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[19] C. W. Wahl, "Some Antecedent Factors in the Family Histories of 568 Male Schizophrenics of the United States Navy," *American Journal of Psychiatry 113* (1956): 201-10.

[20] Herbert Barry, III, and Herbert Barry, Jr., "Birth Order, Family Size and Schizophrenia," *Archives of General Psychiatry 17* (1967): 435-40.

[21] L. Erlenmeyer-Kimling, Elyse Van den Bosch, and Bruce Denham, "The Problem of Birth Order and Schizophrenia: A Negative Conclusion," *British Journal of Psychiatry 115* (1969): 659-78.

[22] Colin M. Smith and Sharon McIntyre, "Family Size, Birth Rank and Ordinal Position in Psychiatric Illness," *Canadian Psychiatric Association Journal 8* (1963): 244-48.

[23] Lilli Stein, "Morbidity in a London General Practice: Social and Demographic Data," *British Journal of Preventive and Social Medicine 14* (1960): 9-15.

[24] Gregory, p. 58.

FAMILY RELATIONSHIPS AND MARITAL ADJUSTMENT

The relationships within families — between husband and wife, between mother and children, and among siblings — become more complex with each additional family member, both because of the increased number of possible interrelationships and because of possible increased stresses on existing relationships. These changes and the adjustment of various family members — particularly children — have been studied in relation to family size and intervals between births.

A number of studies show that there is generally some decline in successful marital adjustment with increasing family size; however, all the studies cited here have the disadvantage of being done on relatively homogeneous samples, and can therefore not be expected to hold true for other cultural groups without further investigation. Robert Reed used data gathered for the Milbank Memorial Fund Study of Social and Psychological Factors Affecting Fertility to study the relationships between three indices of marital adjustment and the factors of family size and success in controlling fertility.[25] The sample for the original study was drawn from residents of Indianapolis, who were native, white Protestant couples who had been married only to each other, and had been married for 12 to 14 years. The majority of the couples demonstrated good marital adjustment according to questionnaires completed separately by husband and wife and rated by the investigator for three indices: the individual's report of the happiness of his marriage, the degree of disagreement with his spouse, and the degree to which he desired to "improve" his spouse.

The most significant relationship between declining marital adjustment and increasing family size was shown for husbands reporting the happiness of their marriages, as shown in Table 14. The same trend appeared for other indices of marital adjustment, though not to such a marked extent. In seeking reasons for the inverse relation between family size and marital adjustment, Reed pointed out that success in controlling fertility, regardless of family size, was important to successful marital adjustment, and that since large family size frequently represented a failure in fertility control, this might underlie the relationship between poor marital adjustment and large family size.

Other studies support Reed's conclusion on the importance of successful control of fertility. Christensen and Philbrick conducted a study

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[25] Robert B. Reed, "Social and Psychological Factors Affecting Fertility: VII. The Interrelationship of Marital Adjustment, Fertility Control, and Size of Family," *Milbank Memorial Fund Quarterly* 25 (1947): 383-425.

TABLE 14

Happiness of Marriage and Family Size

Size of family (number of living children)	Percent reporting happy marriage		
	Wives	Husbands	Couples
0	58.5	62.6	40.7
1	53.5	52.0	34.8
2	50.5	49.7	32.4
3	45.9	49.4	32.0
4+	39.7	32.6	19.9

SOURCE: Robert B. Reed, "Social and Psychological Factors Affecting Fertility: VII. The Interrelationship of Marital Adjustment, Fertility Control, and Size of Family," *Milbank Memorial Fund Quarterly* 25 (1947): from Table 6, p. 392.

of 346 married student couples at Purdue University; the couples had three or fewer children and one member of the couple was a veteran and student, a fairly homogeneous sample.[26] The investigators found that "the presence and number of children may affect any given marriage either way." Using the Burgess-Cottrell-Wallin Marriage Adjustment Form and additional questions of their own, they found the best marital adjustment in couples who were successful in controlling fertility according to their wishes about whether or not and when to have children. These and other articles which lend support to this theory are reviewed in an article by Christensen in which he also points out that since large family size often represents failure to control fertility, it is not surprising that large family size is often associated with poor marital adjustment.[27]

BEHAVIORAL AND EMOTIONAL PROBLEMS IN CHILDREN

In two meticulous studies which were unfortunately handicapped by very small sample sizes, Waldrop and Bell investigated the relation between family size and density and two types of behavior: lethargy in newborn infants and dependency in preschool children. The investigators hypothesized that the infants of mothers who had experienced many closely spaced pregnancies would be "lethargic." To test the hypothesis, infants between 51 and 80 hours old were tested twice to determine the rate at which they sucked on a sterile nipple, the length of time between removal of the nipple and the infant's first cry, and the length and intensity of the crying. These measurements were combined to form an index of the infant's lethargy. The authors felt that their study showed a significant correlation between lethargy and large family size and high "density," and they suggested that a "congenital component" might be indicated.[28]

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[26] Harold T. Christensen and Robert E. Philbrick, "Family Size as a Factor in the Marital Adjustments of College Couples," *American Sociological Review* 17 (1952): 306-12.

[27] Harold T. Christensen, "Children in the Family: Relationship of Number and Spacing to Marital Success," *Journal of Marriage and the Family* 30 (1968): 283-89.

In an earlier study of preschool children and in a follow-up of the infants tested, Waldrop and Bell reported on dependency behavior in children from large families in which children were close in age. One study involved 44 boys, the other was a follow-up of 55 of the lethargic infants. The children were observed during four weeks at a research nursery school and were also rated daily by the two teachers, one male and one female, on such factors as "initiated contact with female teacher." They found a correlation of .36 ($p < .01$) in the follow-up of the lethargic newborns from high size and density families. In the 44 boys studied earlier, it was found that "preschool boys between the ages of two and three who come from homes where family size and density are high will seek more contact with a female teacher than will boys of the same age who come from homes where family size and density are low."[29] The authors postulated that the dependency behavior resulted from less maternal availability in large families than in small ones.

Two studies of older children indicate that particular kinds of emotional problems seemed to increase with increasing family size. Hawkes, Burchinal, and Gardner conducted an examination of 256 fifth grade children in rural areas in the Midwest in which they found that children from small families had better relations with their parents and siblings than children from large families.[30] Tuckman and Regan analyzed data for 1,581 children from a larger group referred to outpatient psychiatric clinics.[31] They did separate analyses to correlate the types of problems for which the children were referred with sex, race, age group, and family size. In regard to family size, they found that "only" children were underrepresented in the sample and that those from families with three or more children were overrepresented as compared with their proportions in the city's population. They also found for the clinic patients that "as family size increased, school problems and antisocial behavior increased, while anxiety and neurotic behavior and problems involving habit formation decreased."

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[28] Mary F. Waldrop and Richard Q. Bell, "Effects of Family Size and Density on Newborn Characteristics," *American Journal of Orthopsychiatry 36* (1966): 544-50.

[29] Mary F. Waldrop and Richard Q. Bell, "Relation of Preschool Dependency Behavior to Family Size and Density," *Child Development 35* (1964): 1187-95.

[30] Glenn R. Hawkes, Lee Burchinal, and Bruce Gardner, "Size of Family and Adjustment of Children," *Marriage and Family Living 20* (1958): 65-68.

[31] Jacob Tuckman and Richard A. Regan, "Size of Family and Behavioral Problems in Children," *Journal of Genetic Psychology 111* (1967): 151-60.

MATERNAL CARE

In the area of maternal care, two British studies, *A Thousand Families in Newcastle Upon Tyne*[32] and *Children Under Five,*[33] reported a correlation between large family size and consistently unsatisfactory maternal care; poor care of children was also associated with unstable families, poor maternal health, and poor, crowded living conditions. In *Children Under Five,* Douglas and Blomfield reported that the proportion of mothers rated best in all aspects of maternal care was 44.7 percent for those with one child as compared to 10 percent for those with five or more. Maternal inefficiency may be both a problem resulting from large families and a factor contributing to other problems associated with large family size, such as illness and slow development in children.

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[32] Spence, p. 126.
[33] Douglas and Blomfield, p. 48.

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FAMILY PLANNING VARIABLES AND THE GROWTH, DEVELOPMENT, AND INTELLIGENCE OF CHILDREN

A child's physical growth and emotional and intellectual development are particularly crucial aspects of the overall family health picture. The consequences of childhood experience not only affect an individual throughout his entire life but may affect his progeny as well. For example, Kincaid demonstrated that women in the British Perinatal Mortality Survey who are "small" suffered more stillbirths than those who had attained "medium" or "large" size; he further demonstrated that the "small" women were often from large, poor families. (See Chapter 2.)

Evidence that large family size may be detrimental to children's growth and development has been collected from a variety of cultural settings. Because of the many competing variables (genetic and environmental) and the lack of precise culture-independent measurements of physical and mental development, however, these data must be interpreted cautiously. It is unfortunate that direct cross-cultural comparisons are almost meaningless. What may be "normal" in one country may be below "normal" in another; for example, Wray and Aguirre found in their study of malnutrition in Colombia that children who were classified as "normal" according to Mexican standards were at the 25th percentile level of "normal" for North American children.[1]

In the areas of intelligence and personality development, the evidence on the effect of family size is interesting but equivocal. In these areas even more than in the area of physical growth, standards are culturally determined and measurement is difficult. Types of behavior and physical and intellectual abilities that may be valued in some cultures may be considered undesirable or worthless in others. However, it is clear that family size is often important in the determination of personality and probably of intelligence as well.

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[1] Joe D. Wray and Alfredo Aguirre, "Protein-Calorie Malnutrition in Candelaria, Colombia—I. Prevalence; Social and Demographic Causal Factors," *Journal of Tropical Pediatrics* 15 (1969): 78.

PHYSICAL GROWTH AND DEVELOPMENT: BIRTH WEIGHT

Since physical size and development are good indicators of infants' and children's health, a number of studies have been conducted to measure birth weight and physical development in relation to such factors as family size, socioeconomic circumstances and maternal age, parity, health, nutrition, and prenatal care. Birth weight has been widely studied since it is one piece of information that is available for virtually all hospital births; furthermore, it gives some indication of an infant's health and maturity. Most studies of birth weight conducted in developing nations as well as in industrialized countries indicate an increase in mean birth weight with parity at least for the first few birth orders. For high birth orders, however, a number of investigators have found a drop in average birth weight or even an increase in the rate of prematurity (or immaturity, as measured by birth weight). The etiology of prematurity is of great concern since even though premature infants represent only a small percentage of all live births, they account for a disproportionately large percentage of the neonatal deaths.

A number of studies of the records of large series of births in western Europe and the United States have examined factors that may be important in the determination of birth weight. In Britain, Karn and Penrose analyzed data on 13,730 infants born at the University College Obstetric Hospital between 1935 and 1946.[2] The sample included information on stillborn infants and those who died within 28 days of birth; these "non-survivors" were "significantly lighter at birth" than the survivors and had been borne by "somewhat older" mothers. Analyzing data for the infants who survived for at least 28 days, the authors found a positive and significant correlation between birth weight and parity, a correlation that was only slightly diminished when maternal age was considered. For males, the mean birth weight in pounds rose steadily from 7.205 for first births to 8.174 for ninth and later births; for females, birth weight ranged from 6.982 to 7.820.

Using the same methods as Karn and Penrose, Fraccaro drew similar conclusions based on a sample of 5,486 Italian births for the years 1942-51 in the Clinica Obstetrica of the University of Pavia.[3] He reported that the non-survivors in his sample were also of lower birth weight and had been born to older mothers than the survivors. Among the survivors — although the Italian infants were on the average lighter than the British infants — there was an increase in birth weight with parity up to about the eighth birth, after which there seemed to be a drop in average birth weight; he also recorded some increase in birth weight with maternal age.

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[2] Mary N. Karn and L. S. Penrose, "Birth Weight and Gestation Time in Relation to Maternal Age, Parity and Infant Survival," *Annals of Eugenics 16* (1951): 147-64.

Jayant, using the original data of the University College study, suggested an important qualification to the apparent birth weight advantage of later-born infants reported in these and other studies.[4] Comparing first and second births with all births beyond the second, Jayant found that although there was no significant difference for critical birth weights for different birth positions, there was an increase in optimal birth weight with parity. ("Critical birth weight" was defined as "the weight at which the proportion of infants who survive is the same as the average"; and "optimal birth weight" was defined as "the weight at which the survival rate is highest.")

Two British studies on prematurity — one by Douglas and one by Baird — emphasize the influence of such factors as maternal age, health, and prenatal care. Douglas' study was based on birth weight data which were collected for more than 13,000 infants as part of a maternity survey conducted in 1946 by a Joint Committee of the Royal College of Obstetricians and Gynaecologists and the Population Investigation Committee.[5] Unfortunately, Douglas did not provide tabulations or summaries of the relationship of birth weight and birth order since he was concerned only with prematurity (as indicated by birth weights of five and one-half pounds or less). He considered first births separately from all later births and found that after standardizing for birth interval, premature births accounted for about five percent of all second and later order births, with little variation with parity. The lowest prematurity level (ranging from 3.1 to 3.8 percent) was found among women between the ages of 25 and 35 with intervals of three to six years since previous births. For women under 25 who had shorter intervals between pregnancies (two years or less), prematurity was the highest, ranging from 6.9 percent for second births to 7.7 percent for fourth and later births. Thus, Douglas concluded that birth intervals, maternal age, and a variety of social and medical care factors were responsible for the variations in prematurity rates, and that birth order did not "appear to be associated with prematurity."

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[3] M. Fraccaro, "A Contribution to the Study of Birth Weight Based on an Italian Sample," *Annals of Human Genetics 20* (1956): 282-97.

[4] Kasturi Jayant, "Effect of Parity on Optimal and Critical Birth Weights," *Annals of Human Genetics 29* (1966): 363-65.

[5] J. W. B. Douglas, "Some Factors Associated with Prematurity," *Journal of Obstetrics and Gynaecology of the British Empire 57* (1950): 143-70.

Baird, who considered only primiparas delivered in Aberdeen, showed the association between maternal size and social class and prematurity, which he found to vary from a low of 3.8 percent among tall women in the highest social classes to a high of 14.3 percent in small women of the lowest social classes.[6]

A number of American studies confirm these European reports of an increase in birth weight with parity and of the influence of various maternal and environmental influences on prematurity. Some studies in the United States also show some independent association between parity and prematurity.

In an attempt to discover the reasons for the average lighter birth weight for Negro infants as compared to white, Crump, Horton, Masuoka, and Ryan investigated a number of factors in three samples of American Negroes and found a slight positive association between birth weight and maternal age, socioeconomic status, and parity (ranging from a mean of 2.98 kilograms for first births to 3.20 for eighth and later births).[7]

Wiener and Milton, in a statistical study of 100,277 certificates of live birth in Baltimore City for the period 1961-65, found that the variation in rates of low birth weight with parity was fairly small, especially as compared with the high rates of low birth weight among Negro infants as compared to whites and among the low socioeconomic group as compared to the high group.[8] The percentage of low birth weight infants increased steadily and significantly above the average rate for the population of 11 percent with delays in obtaining prenatal care and was, therefore, highest among women for whom no prenatal care was recorded. Partial correlation and multiple regression analyses showed that race and trimester in which prenatal care was first obtained were independently associated with birth weight, while other factors, including parity, were of less importance in explaining low birth weight.

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[6] Dugald Baird, "The Epidemiology of Prematurity," *Journal of Pediatrics 65* (1964): 909-24.

[7] E. Perry Crump, Carrell P. Horton, Jitsuichi Masuoka, and Donnalda Ryan, "Growth and Development—I. Relation of Birth Weight in Negro Infants to Sex, Maternal Age, Parity, Prenatal Care, and Socioeconomic Status," *Journal of Pediatrics 51* (1957): 678-97.

[8] Gerald Wiener and Toby Milton, "Demographic Correlates of Low Birth Weight," *American Journal of Epidemiology 91* (1970): 260-72.

The authors did feel that it was possible to sketch a profile of a high risk population from their data: "The greatest risk for having a low birth weight infant is borne by a population of women who have no medical care, are Negro, not married, under 15 years of age, are having their first child, and are of the lowest SES [socioeconomic status]. The expected low birth weight rate for this group is 29.5."[9] The findings of Donnelly and his associates from the records of 29,561 deliveries at three North Carolina hospitals during the years 1954 through 1961 confirm some parts of this high risk profile.[10] For example, they found that the incidence of prematurity was high in women under 20 years of age from the less favored socioeconomic classes. They felt that "birth order per se did not exert a significant influence on the incidence of prematurity."

Further insight into this problem comes from the large study of all births and related death certificates filed in the United States (except Massachusetts where birth weight was not uniformly available) for children born between January 1 and March 31, 1950.[11] This study is unique among those summarized here in that it correlates both mean birth weight and prematurity with parity. Among the 208,618 children included in the study, mean birth weight rose with birth order, but births of immature infants (2500 grams or less) were most frequent for first births and for fifth and later births. It was found that median birth weight also increased with mother's age but that the rate of immature births was fairly high among mothers under 20, at a minimum for those between 25 and 29, and rose again thereafter. This profile for maternal age and prematurity (or immaturity) has been reported by other investigators as well, for example by Bishop in his study of prematurity in Pennsylvania.[12]

A sampling of studies from Africa, India, and Singapore shows a concern with the factors associated with birth weight. Roberts and Tanner studied the records of 1,624 births for the period 1952-57 for Hangaza, a Bantu-speaking people in Tanganyika, and found that birth weight generally increased with parity.[13] Simpkiss reported similar results in a study in Uganda, with slightly heavier average birth weights at all parities for Bantu as opposed to non-Bantu samples.[14]

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[9] *Ibid.*, p. 264.

[10] James F. Donnelly *et al.*, "Maternal, Fetal and Environmental Factors in Prematurity," *American Journal of Obstetrics and Gynecology 88* (1964): 918-31.

[11] Jeanne Loeb, "Weight at Birth and Survival of Newborn, by Age of Mother and Total-Birth Order: United States, Early 1950," *Vital and Health Statistics,* Series 21, Number 5 (1965).

[12] Edward H. Bishop, "Prematurity: Etiology and Management," *Postgraduate Medicine 35* (1964): 185-88.

[13] D. F. Roberts and R. E. S. Tanner, "Effects of Parity on Birth Weight and Other Variables in a Tanganyika Bantu Sample," *British Journal of Preventive and Social Medicine 17* (1963): 209-15.

Datta Banik, in an Indian study, analyzed a series of 1,470 single births and found that up to maternal ages of 26-30, there was a tendency for the mean birth weight of infants to increase with maternal age, whereas at higher ages, this relationship was reversed.[15] The mean birth weight tended to increase with parity up to the third or fourth birth, but there was no consistent pattern for higher birth order. An inverse relationship with socioeconomic status was also found.

Millis and Seng studied the records of 18,425 Chinese infants born in Singapore in 1950-51 (one-fourth of all the Chinese births in the colony).[16] Their statistical analysis led them to conclude that "holding age constant the average birth weight tends in the main to increase with parity," but that the *rate* of increase becomes progressively slower. They also found that for each maternal age group there are one or two birth orders at which birth weight is maximized and beyond which average birth weight decreases. For example, for infants of mothers under 30, birth weights are on the average at a maximum up to the sixth birth (female infants) or seventh birth (male infants), and decline thereafter. This pattern may reflect the influence of short birth intervals in young mothers — a factor not considered in this analysis. For infants of mothers over 30, maximum average birth weight is achieved for seventh to ninth birth orders and decreases thereafter.

A generally similar analysis was performed by Namboodiri and Balakrishnan on data for 12,640 deliveries in two South Indian hospitals during 1956 and 1957.[17] They found — as had Millis and Seng — that birth weights generally increased with parity within fixed maternal age groups, but with "the rate of this increase tending to diminish with parity."

Thus, judging from the data presented here, later-born children may on the average have an advantage in birth weight over early-born children — at least through the first few birth orders. Most studies of prematurity acknowledge the greater risk for first births, and some point in the direction of high risk again for high birth orders.

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[14] M. J. Simpkiss, "Birth Weight, Maternal Age and Parity Among the African Population of Uganda," *British Journal of Preventive and Social Medicine* 22 (1968): 234-37.

[15] N. D. Datta Banik, R. Krishna, S. I. S. Mane, and Lila Raj, "A Study of Birth Weight of Indian Infants and Its Relationship to Sex, Period of Gestation, Maternal Age, Parity and Socio-economic Classes," *Indian Journal of Medical Research* 55 (1967): 1378-85.

[16] Jean Millis and You Poh Seng, "The Effect of Age and Parity of the Mother on Birth Weight of the Offspring," *Annals of Human Genetics* 19 (1954): 58-73.

[17] N. K. Namboodiri and V. Balakrishnan, "On the Effect of Maternal Age and Parity on the Birth Weight of the Offspring (Indian Infants)," *Annals of Human Genetics* 23 (1959): 189-203.

GROWTH AND DEVELOPMENT BEYOND INFANCY

The apparent though sometimes disputed birth weight advantage of high birth order infants over low birth order infants makes all the more dramatic the observed disadvantage of children from large families when compared with children from small families for physical growth and development. Scott linked data on height and weight of London school children with their achievement on verbal reasoning tests and their family size; he found that height, weight, and verbal reasoning ability varied inversely with family size.[18] M. W. Grant undertook a nine-year study of children's growth patterns and, in addition to gathering long-range data on individuals, was able to compare consecutive siblings in some families. This study involved 1,061 families with 1,310 children and led to the conclusion that "the smaller size of children in large families is common to all of them and . . . the first-born does not achieve the height and weight attained by first-borns who remain only children."[19] It seems that later-born children in large families may retain some of the advantage of their higher birth weight in relation to their older siblings, but they do not generally match the average height and weight of children the same age who grow up in small families. Some of the height and weight measurements correlated with family size are shown in Table 15.

Douglas and Simpson examined information on 1,557 boys and 1,456 girls as part of the British National Survey of Child Health and Development to try to determine the influence of family size and social class on the age of onset of puberty.[20] Measures of weight and height were available for all the subjects at ages seven, eleven, and fifteen, and school doctors made a note of the degree of the children's sexual maturity at ages eleven and fifteen. The percentage of boys sexually mature at fifteen and of girls with early onset of menses (by age twelve) decreased with family size, as shown in Table 16.

Among the explanations these authors suggest for the association between family size and slow physical development are that social

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[18] J. A. Scott, "Intelligence, Physique, and Family Size," *British Journal of Preventive and Social Medicine 16* (1962): 165-73.

[19] M. W. Grant, "Rate of Growth in Relation to Birth Rank and Family Size," *British Journal of Preventive and Social Medicine 18* (1964): 35-42.

[20] J. W. B. Douglas and Howard R. Simpson, "Height in Relation to Puberty, Family Size and Social Class: A Longitudinal Study," *Milbank Memorial Fund Quarterly 42* (1964): 20-35.

TABLE 15

Family Size and Measures of Children's Physical Growth and Development

Family size (number of children)	Mean height (in centimeters) and weight (in kilograms) at about 11.25 years for one group from Scott's study				Mean height (in centimeters) and weight (in kilograms) at about age 12 for Grant's subjects			
	Boys		Girls		Boys		Girls	
	Height	Weight	Height	Weight	Height	Weight	Height	Weight
1	144.2 ± .37	37.01 ± .36	145.3 ± .43	38.67 ± .45	147.9	39.5	150.3	43.4
2	143.4 ± .34	35.23 ± .33	144.8 ± .37	37.08 ± .39	147.5	39.7	149.1	40.7
3	142.4 ± .48	34.13 ± .46	143.9 ± .54	36.15 ± .56	145.9	37.0	148.9	40.4
4	142.8 ± .76	34.63 ± .74	142.7 ± .74	34.62 ± .77	145.1	36.9	145.6	36.8
5+	140.2 ± .80	32.47 ± .78	140.4 ± .98	32.76 ± 1.02	143.7	35.7	145.8	37.9

SOURCES: J. A. Scott, "Intelligence, Physique, and Family Size," *British Journal of Preventive and Social Medicine 16* (1962): 166; and M. W. Grant, "Rate of Growth in Relation to Birth Rank and Family Size," *British Journal of Preventive and Social Medicine 18* (1964): 37.

TABLE 16

Age at Puberty by Family Size

Size of family (number of children)	Percent of boys mature at age 15	Percent of girls with early onset of menses (age 12)
1	62.1	54.3
2	56.7	38.8
3	54.3	38.3
4+	49.6	31.4

SOURCE: J. W. B. Douglas and Howard R. Simpson, "Height in Relation to Puberty, Family Size and Social Class: A Longitudinal Study," *Milbank Memorial Fund Quarterly* 42 (1964): extracted from Table 2, p. 23.

class effects may be partly responsible, that diet may be poor, and that infections may be frequent and poorly ministered to in large families. Almost uniformly, the investigators advocate additional research on the interactions of these factors.

PERSONALITY DEVELOPMENT

Several researchers have investigated the effects of family size and birth order on personality development. In Chapter 5, we dealt with *problems* of personality development and mental adjustment; here we wish merely to emphasize findings which show that family size as well as birth order are important in shaping children's personalities, without assessing the value of the various types of behavior patterns associated with different-size families.

Pioneering work in the field was done by Bossard and Boll and is reported in their book, *The Large Family System.*[21] Their inquiries were based on case history studies of one hundred families with six or more children. Although these families may have been atypical (for example, most were from farms or small towns), the researchers' chief purpose was to define directions for future research and some of their tentative conclusions are interesting. They found that "types" of personality associated with both large family size and birth order seemed to emerge — for example, older children often assumed considerable responsibility at an early age; youngest children were not infrequently "spoiled."

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[21] James H. S. Bossard and Eleanor Stoker Boll, *The Large Family System: An Original Study in the Sociology of Family Behavior* (Philadelphia: Univ. of Pennsylvania Press, 1956).

Other investigators have generally studied the association of some particular personality trait with family size. Rosen is very insistent that in examining such personality factors as achievement motivation, a number of interdependent variables — of which family size is one — need to be taken into consideration.[22] Rosen investigated achievement motivation in boys, as measured by a "thematic apperception-type test," by comparing two groups. Group A was heterogeneous and consisted of 427 mother and son pairs from four northeastern states; Group B consisted of boys of mean age ten from homogeneous backgrounds in four Connecticut schools. Among the factors matched with achievement motivation scores were family size, ordinal position, social class, and maternal age. In general, with regard to family size alone, the smaller the family, the higher the child's achievement motivation. However, detailed analysis showed that particular constellations of the several demographic factors considered were consistently associated with high achievement motivation, as indicated by the following example:

> the effect of birth order is intimately related to family size and social class. Hence it is not very helpful in predicting an individual's achievement motivation to know his position in the birth order — indeed this information may be misleading rather than useful — unless the social class and size of his family of orientation are also known. In small middle class families, for example, the effect of ordinal position seems to be relatively unimportant: the oldest and youngest child in a two-child, middle class family have almost identical motivation scores, but *as the size of the family increases* the scores for the oldest child *in the middle class* become higher than those for the youngest child. However, *in the lower class* the reverse is true: the youngest child has a higher achievement motivation score on the average than the oldest child — a position that is maintained even when the size of the family increases.[23]

Another investigator who emphasizes family size as "a significant factor" in the study of birth order effects is Jamieson, who found that children from large families are more likely to engage in risk-taking behavior than are children from small families.[24] He suggests that this may be the case because dependency behavior is fostered by small family interactions, while independence is encouraged in children in large families. Stagner and Katzoff, on the other hand, concluded as a result of tests on 430 college men that birth order is not significant in personality development, although they do suggest a "slight" —

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[22] Bernard C. Rosen, "Family Structure and Achievement Motivation," *American Sociological Review* 26 (1961): 574-85.

[23] *Ibid.*, p. 585; quoted by permission of Dr. Rosen.

[24] B. D. Jamieson, "The Influences of Birth Order, Family Size and Sex Differences on Risk-Taking Behaviour," *British Journal of Social and Clinical Psychology* 8 (1969): 1-8.

though unspecified — "advantage" to growing up in a small family, and they do suggest that displacement of early-born children by those later-born may promote the development of greater independence in the former.[25]

INTELLIGENCE AND MENTAL DEFICIENCY

This is an interesting area for investigation, but one in which the few good studies that have been done have been miserably diluted with a large number of ill-designed ones which have made sweeping and often unfounded conclusions.

For example, a number of studies based on highly selected samples of geniuses, university professors, science competition winners, and distinguished persons whose *vitae* appear in genealogical reference works, have produced conflicting evidence on whether or not individuals from small families are overrepresented in such groups.[26] It therefore seems highly desirable that careful studies of the relationship between sibship size and ability or achievement should be carried out, with competing independent variables being carefully controlled.

Among the better studies of intelligence and family size are two extensive surveys, the results of which are summarized by Anastasi.[27] In a French survey in 1943-44, two percent of the children in elementary school between the ages of six and twelve were tested; the total number was 95,237 and was representative of 20 regions of the country. The mean test scores on René Gille's intelligence test dropped consistently as size of sibship increased. The mental age of children with no siblings was one or two years higher than that of those with seven or more siblings. The association was more apparent among the children of farmers, manual laborers, and clerical workers and was barely discernible in the children of professionals.

In the Scottish Council Survey of 1947, a group IQ test was administered to virtually the total population of eleven-year-old children in Scotland, a total of 70,805. It was found that children's IQ levels decreased with increase of sibship size for the total sample, and when a Stanford-Binet test was individually administered to a subsample of

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[25] Ross Stagner and E. T. Katzoff, "Personality as Related to Birth Order and Family Size," *Journal of Applied Psychology 20* (1936): 340-46.

[26] Corrado Gini, "Superiority of the Eldest," *Journal of Heredity 6* (1915): 37-39; William D. Altus, "Birth Order and Its Sequelae," *Science 151* (1966): 44-49; W. E. Key, "Order of Birth Unimportant in Achieving Fame," *Journal of Heredity 17* (1926): 150; and Lois-Ellin Datta, "Birth Order and Potential Scientific Creativity," *Sociometry 31* (1968): 76-88.

[27] Anne Anastasi, "Intelligence and Family Size," *Psychological Bulletin 53* (1956): 187-209.

1,215 children the trend of this association was maintained. The average IQ for "only" children was 113, compared to 91 for children in families of five or more. This pattern of association existed within each social class, as determined by occupation of parents. The differential between children from large and small families agreed with an earlier survey by the Council in 1932, although the 1947 results showed an average improvement in intelligence over the 1932 results.

The Scottish Survey results were confirmed by data from the British National Survey of Health and Development on 5,362 English, Scottish, and Welsh children born in 1946.[28] In all social classes there was a decrease in children's measured intelligence with increasing family size, although the effect was less pronounced in middle class children than in children of manual workers. The investigators were inclined to attribute the family-size effect chiefly to environment, "interpreted in its broadest sense to include deficiencies of parental care as well as of the material background of the home."

Anastasi also summarized studies from England, Greece, Germany, and the United States which indicate a decrease in intelligence with increasing family size. Similarly, a study by Chopra of 1,359 randomly selected high school students in urban and rural schools in the Lucknow district of India showed a gradual decline in mean intelligence test scores and school grades as family size increased.[29]

One of the explanations of these findings on family size and intelligence is that there is likely to be great emotional investment, warmth, and concern on the part of the parents of small families for the physical and mental development of children, whereas in large families, however great parents' concern for their children's well-being, there is simply less opportunity for individual parent-child contact. This smaller degree of contact in large families may be reflected in poorer — or at least slower — development of verbal ability in these children, a factor which may affect the children's performance on intelligence tests. Neligan and Prudham, in their investigations aimed at determining normal milestones in childhood development, found that this was true very early, for they found that the age at which children began to talk increased with birth order.[30]

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[28] J. W. B. Douglas, "Chapter XII: Completed Family Size," *The Home and the School: A Study of Ability and Attainment in the Primary School* (London: MacGibbon and Kee, 1964), pp. 91-100.

[29] Sukhendra Lal Chopra, "Family Size and Sibling Position as Related to Measured Intelligence and Academic Achievement," *Journal of Social Psychology 70* (1966): 133-37.

[30] Gerald Neligan and Derek Prudham, "Norms for Four Standard Developmental Milestones by Sex, Social Class and Place in Family," *Developmental Medicine and Child Neurology 11* (1969): 413-22.

Extensive and careful studies of verbal ability, intelligence, and family size have been done by Nisbet. In a study of two groups of about 2,500 children each, and subsamples from these groups, three different measures were used to test the hypothesis that at least part of the inverse relationship between family size and intelligence could be traced to poorer verbal ability in large families as compared to small families.[31] All three tests confirmed the hypothesis and led Nisbet to conclude that "part of (though not all) the negative correlation of family size and intelligence test score may be attributed to an environmental influence of the size of family on verbal development and through it on general mental development." Another study by Nisbet and Entwistle of 2,868 Aberdeen school children tested at ages seven, nine, eleven, and twelve for verbal and non-verbal reasoning ability and achievement produced the familiar drop in test scores — especially verbal test scores — with increasing family size.[32]

In a more recent study, Record, McKeown, and Edwards matched the verbal reasoning scores (part of the eleven-plus examinations) with birth records for 48,913 of a total of 86,630 Birmingham, England, children born between 1950 and 1954.[33] (Omitted from the sample were multiple births and children who had died, moved away, or for some other reason were not available for study.) The test scores were analyzed according to the following data obtained from birth records: the child's birth order, his mother's age at his birth, and the family's social class (as measured by father's occupation). The verbal reasoning scores show a decline in measured verbal reasoning ability with increasing birth order; this is true of crude scores and of scores standardized to remove the effect of maternal age. (See top half of Figure 19.) Verbal reasoning scores were found to rise with increasing maternal age at birth of the child. Thus, when verbal reasoning scores, maternal age, and birth order were plotted together on the three dimensional diagram shown in Figure 17, the lowest scores (less than 90) appeared for sixth and later children born to mothers between 25 and 30, and the highest (over 105) for first born children to mothers between 35 and 40. When social class, maternal age, and birth order were plotted together, lower scores were recorded for lower social classes, but

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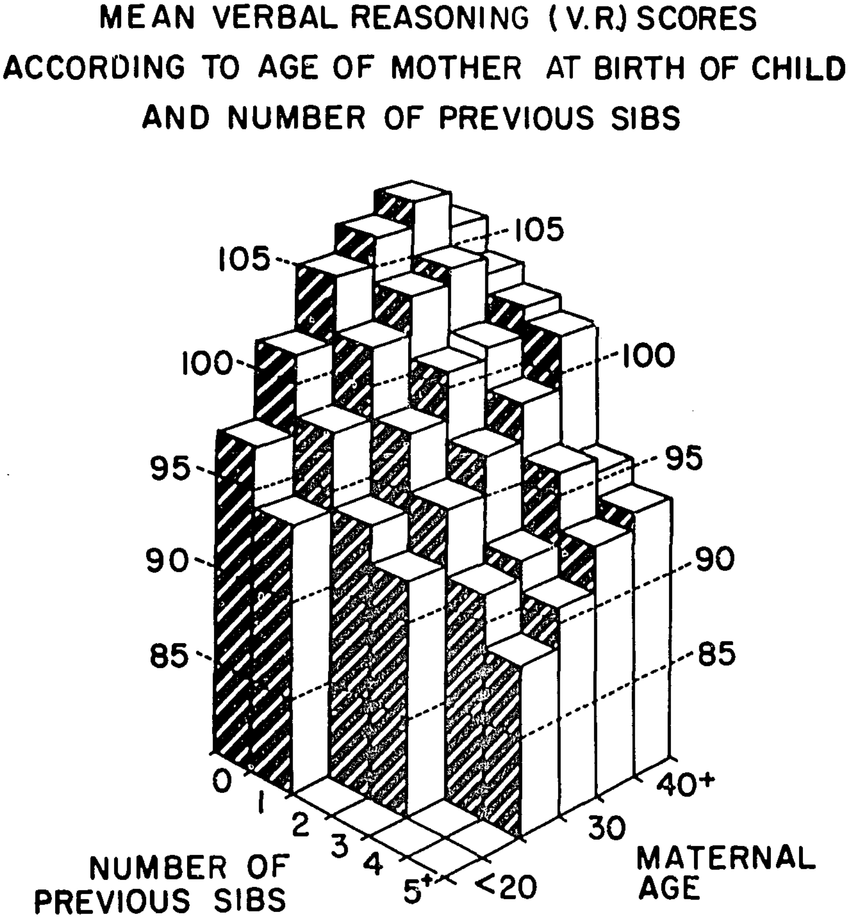
[31] J. D. Nisbet, "Family Environment and Intelligence," *Eugenics Review 45* (1953): 31-42.

[32] J. D. Nisbet and N. J. Entwistle, "Intelligence and Family Size, 1949-1965," *British Journal of Educational Psychology 37* (1967): 188-93.

[33] R. G. Record, Thomas McKeown, and J. H. Edwards, "The Relation of Measured Intelligence to Birth Order and Maternal Age," *Annals of Human Genetics 33* (1969): 61-69.

Figure 17. Mean verbal reasoning scores according to age of mother at child's birth and number of previous sibs shows a positive association with maternal age and a negative association with birth order.

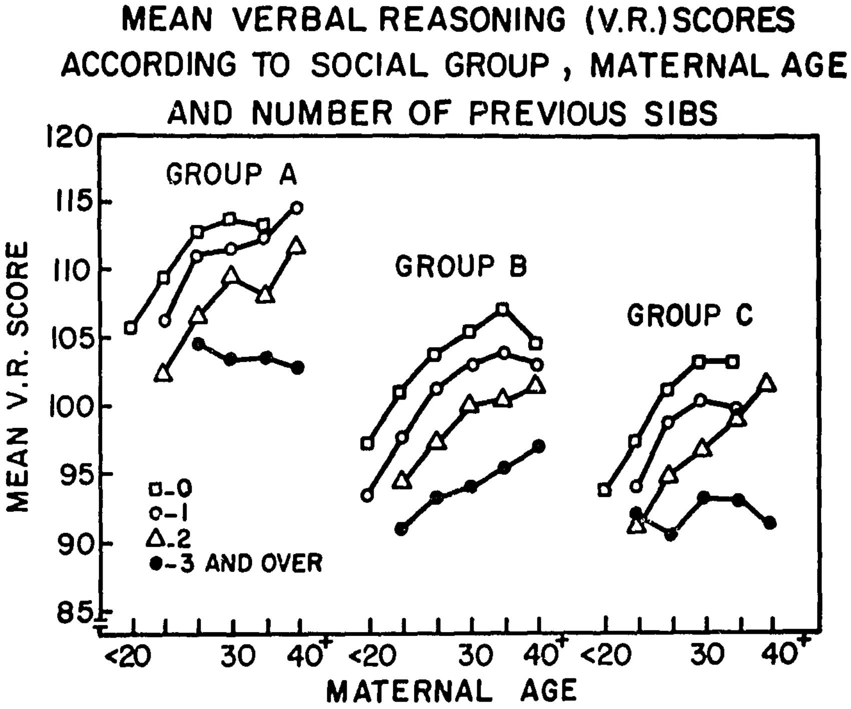


SOURCE: R. G. Record, Thomas McKeown, and J. H. Edwards, "The Relation of Measured Intelligence to Birth Order and Maternal Age," *Annals of Human Genetics* 33 (1969): Figure 1, p. 63; reprinted by permission of Dr. Record.

within each social class, the decrease in verbal reasoning scores with increasing birth order remained evident as shown in Figure 18.

A refinement in this study over previous studies was the matching of 5,083 sibling pairs; comparison of the scores of adjacent siblings from the same family showed only small decreases in scores from early to late birth positions (with the greatest average difference apparent between the first and second children). From this the authors con-

Figure 18. Mean verbal reasoning scores according to social group, maternal age, and birth order show positive association with maternal age, negative association with birth order and with social class. Group A represents the highest social class, B middle classes, and C the lowest social classes.



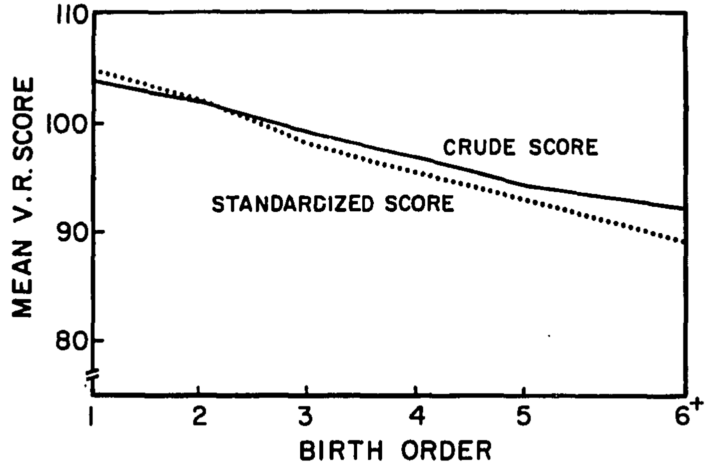
SOURCE: Same as Figure 17, Figure 2, p. 67; reprinted by permission of Dr. Record.

cluded that the association between measured verbal reasoning ability and sibship size was due more to differences *between* families than to differences *within* families. Finally, they concluded that the association "is largely a reflection of the social class differences."

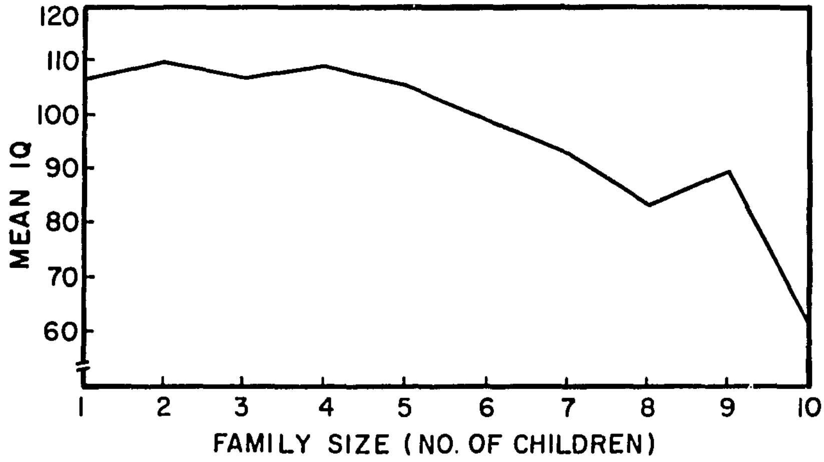
In evaluating the results reported here, it must be considered that a fallacy may exist in some of these IQ–sibship size studies. The higher intelligence of children in smaller families may be dependent, at least in part, upon the generally higher intelligence of their parents. Whether this dependence is genetically or environmentally determined, or both, the association of small family size and high intelligence may be partly secondary.

Figure 19. The graph at the top shows the negative relationship between verbal reasoning scores and birth order; the standardized score eliminates the effect of maternal age. The graph at the bottom shows the decrease in mean intelligence scores with increasing family size.

RELATION OF VERBAL REASONING (V.R.) SCORE TO BIRTH ORDER



SIZE OF FAMILY COMPARED WITH MEAN IQ OF CHILDREN



SOURCES: *Top:* Drawn from data in R. G. Record, Thomas McKeown, and J. H. Edwards, "The Relation of Measured Intelligence to Birth Order and Maternal Age," *Annals of Human Genetics* 33 (1969): Table 3, p. 65.
Bottom: Drawn from data in Elizabeth W. Reed and Sheldon C. Reed, *Mental Retardation: A Family Study* (Philadelphia: W. B. Saunders Co., 1965), p. 65.

Some light has been shed on this problem by an extensive study in Minnesota, carried out through the Dight Institute for Human Genetics and reported by Reed and Reed.[34] The part of their study with which we are concerned involved a subsample of 1,016 families (4,017 individuals) for whom IQ scores were available for *both* parents and at least one child. It was found that the mean IQs of the children for sibship sizes of one to five were similar, but that they dropped significantly for children from sibship sizes of six to ten, as shown in the lower half of Figure 19. Although there are comparatively few families with six or more children, the correlation coefficient of family size and IQ of children was —0.30 ± 0.02, as compared to coefficients of —0.20 to —0.30 in earlier studies.[35] The relation of parents' IQs to the size of the families they produced was similar to that for the children, as shown in Table 17.

A number of other studies failed to produce such a negative correlation between family size and intelligence or between the intelligence of parents and the size of the families they produced; this was particularly true of studies in which the sample populations were highly selected. Collectively, however, the evidence from the literature supports the negative correlation between family size and intelligence levels of children. The correlation coefficients of the majority of studies were negative and clustered around the range —0.20 to —0.30.[36]

MENTAL DEFICIENCY

As to manifest mental deficiency, a few studies have reported a positive relationship with family size. Pasamanick and Lilienfeld, for instance, studied the birth certificates and hospital records of mentally defective children born in Baltimore between 1935 and 1952, and their data suggest that the risk of mental deficiency increases with increasing

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[34] Elizabeth W. Reed and Sheldon C. Reed, *Mental Retardation: A Family Study* (Philadelphia: W. B. Saunders Co., 1965); see especially pp. 64-70.

[35] Because of this negative correlation between family size and children's IQs, it had been postulated that the average IQ of the population would gradually drop as members of large, less intelligent families grew up and reproduced. However, this has not been the case ("Cattell's Paradox"). Higgins, Reed, and Reed have resolved this paradox for their subsample of 1,016, although they suggest that further work needs to be done in this field. They found that if the childless members of each generation are included in the study along with the fertile members, "the higher reproductive rate of those in the lower IQ groups who are parents is offset by the larger proportion of their siblings who never marry or who fail to reproduce when married." J. V. Higgins, Elizabeth W. Reed, and S. C. Reed, "Intelligence and Family Size: A Paradox Resolved," *Eugenics Quarterly* 9 (1962): 84-90.

[36] Anastasi, p. 193.

TABLE 17

Size of Family Compared with Mean IQ of Parents and Children

Family size (number of children)	Number of families	Mean IQ		
		Mother	Father	Children
1	141	102.29 ± 1.34	99.06 ± 1.40	106.37 ± 1.39
2	370	104.50 ± 0.69	101.43 ± 0.71	109.56 ± 0.53
3	287	102.90 ± 0.82	101.17 ± 0.90	106.75 ± 0.58
4	122	104.93 ± 1.10	102.22 ± 1.28	108.95 ± 0.73
5	57	103.44 ± 2.07	103.53 ± 2.30	105.72 ± 1.15
6	21	96.57 ± 4.25	94.90 ± 4.79	99.16 ± 2.17
7	7	90.86 ± 9.85	86.57 ± 9.77	93.00 ± 3.34
8	4	78.00 ± 15.83	79.25 ± 13.84	83.80 ± 4.13
9	5	90.00 ± 11.27	81.00 ± 9.12	89.89 ± 2.94
10	2	65.50 ± 17.66	50.50 ± 3.46	62.00 ± 7.55

SOURCE: Elizabeth W. Reed and Sheldon C. Reed, *Mental Retardation: A Family Study* (Philadelphia: W. B. Saunders Co., 1965), p. 65; reprinted by permission of Dr. Sheldon Reed.

birth order. The group was compared with a matched control group, from which the expected rate of mental deficiency was obtained.[37]

Although lacking the advantage of a matched control, an earlier study of retarded children in the Massachusetts public schools by Dayton reported a significant relationship between retarded children's mean sibship size and the degree of retardation.[38] Dayton concluded that "families having a retardate are larger than the average family in the general population and families having a mental defective are still larger." Regarding the possible deterrent effect of a child's retardation on the parents' reproductive behavior, the author suggested that except in cases of extreme retardation (mongolism, for example) the presence of a defective child did not generally lead at that time to voluntary limitation of family size by the parents.

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[37] Benjamin Pasamanick and Abraham M. Lilienfeld, "Association of Maternal and Fetal Factors with Development of Mental Deficiency—I. Abnormalities in the Prenatal and Paranatal Periods," *Journal of the American Medical Association* *159* (1955): 155-60.

[38] Neil A. Dayton, "Order of Birth and Size of Family," *American Journal of Psychiatry* *8* (1929): 979-1006.

7

HEALTH ASPECTS OF ABORTION

Abortion is or has the potential for being a serious individual and community health problem in many areas of the world, the major threat being to the life and health (both physical and mental) of the mother when abortions are performed illegally, inexpertly, and under poor environmental conditions.

The ever-accumulating epidemiologic and sociologic literature indicates that abortion has nevertheless been increasing in many areas of the world and has reached or threatens to reach epidemic proportions in a number of these areas. The factors contributing to this high prevalence vary from one country to another and may depend on, among other things, the stage of the demographic transition through which a particular country is passing, as well as the state of the abortion laws and the attitudes of the public and medical profession toward abortion.

The purpose of this chapter is to consider in brief:

1. The legal status of abortion in various countries
2. The incidence of abortion in various countries
3. The medical sequelae of abortion
4. Mortality as an indicator of abortion safety
5. The psychiatric consequences of abortion
6. Medical and social costs of abortion and prospects for attenuating the abortion problem

LEGAL STATUS OF ABORTION

The practice of abortion for the purpose of controlling fertility can be traced back to ancient times; it is recorded in the literature of the Chinese, Egyptians, Greeks, and Romans and existed in primitive societies as well.[1] Although abortion was accepted or at least tolerated by some cultures, its legality, morality, and advisability were disputed by Greek philosophers. The origin of the traditional reluctance on the part of physicians to perform abortions has been attributed to Hippocrates and the Hippocratic oath which states, "To please no one will I prescribe a deadly drug, nor give advice which may cause his death. Nor will I give a woman a pessary to procure abortion." Because of the criminal shadow which was thus cast upon the performance of abortion, some physicians are deterred from the practice even today.

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[1] Frederick J. Taussig, *Abortion: Spontaneous and Induced — Medical and Social Aspects* (St. Louis: C. V. Mosby, 1936), pp. 31-32.

Until recent years, abortion has been almost universally illegal; statutes have existed in nearly every country forbidding the practice of abortion — except perhaps when pregnancy threatened the life of the mother. These laws are the result of several factors, such as religious and moral compunctions, pro-natalist attitudes of nations expanding geographically or economically, and the prevalence of crude and dangerous abortion techniques. In modern times, however, some of these reasons no longer seem valid, and others are hotly disputed. The position of world religions regarding abortion is undergoing a re-examination; pro-natalist policies are being abandoned by nations which see rapid population growth as a deterrent to social and economic development; and abortion techniques which are safe when used by trained medical personnel have been developed and are constantly being improved. These changes are being reflected in the contemporary trend toward liberalization of abortion laws in many countries around the world.[2]

The most liberal laws have been adopted by Japan (1948), the Soviet Union (1955), Hungary (1956), Poland (1956), Czechoslovakia (1957), Yugoslavia (1960), Bulgaria (1956), and Rumania (1956, but restricted again in 1966). Abortion can be obtained in these countries without procedural delay either on request or for a wide variety of demographic, economic, social, and medical reasons. The most recent and most radical change was the complete abolition of abortion law in New York State (1970), where the decision of whether or not an abortion is to be performed is now made by a woman and her physician.

Fairly liberal laws have been adopted by a number of other countries such as Sweden (1938, liberalized further in 1946), Denmark (1939, liberalized further in 1956), Norway (1960), Finland (1950), and Iceland (1935). According to the laws of these countries, a woman may obtain a legal abortion for some or all of the following indications: potential damage to the mother's physical or mental health from continuation of the pregnancy; danger that the child will be physically deformed or mentally deficient (as a consequence either of hereditary factors or as a result of maternal illness or exposure to drugs or radiation); potential social or economic hardship for the mother or her family in the event of the birth of the child. In some of these countries, the decision as to whether or not the abortion can be performed is made by a review committee, which may limit the liberality of the law, may put an undue strain on the woman waiting for a decision, and may cause a dangerous delay in the performance of the operation if it is ultimately approved.

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[2] See Part III, "The Legal Aspects of Abortion," and Part V, "The Global Aspects of Abortion," in Robert E. Hall, ed., *Abortion in a Changing World* (New York: Columbia Univ. Press, 1970), Vol. I.

In more recent years, liberal laws have also been adopted in the United Kingdom (1967), Tunisia (1966), and probably in mainland China, as well as in a number of states in the United States (since the mid-1960's). Although the Tunisian law restricts abortion to women already having five children, the new law represents a revolutionary reversal in an area historically bound by rigid traditionalism.

The legal codes of many countries still retain restrictive abortion laws, and induced abortion is absolutely prohibited or allowed only for strict medical indications. In some countries, however, the law is not enforced or a very broad interpretation is given to a law allowing abortion in order to preserve the mother's life or health. Thus, in countries where the intent of the law and actual practice are widely divergent and application of the law is inconsistent, the ability of a woman to obtain a "legal" or nominally therapeutic abortion may be dependent on her social, financial, and educational level. Currently, however, some of these countries are in the process of revising their laws; in Chile and India, for example, liberalization is pending.

INCIDENCE OF ABORTION IN DEVELOPED COUNTRIES

In most countries, statistics on the performance of abortion are incomplete and unreliable — if they are available at all. Where abortion is legal and systems for the registration of vital statistics are good, however, fairly reliable figures for legally performed abortions are available.

Except in the Scandinavian countries where abortions are relatively difficult to obtain, the number of abortions and abortion ratios per 1,000 live births have risen visibly over time in those countries where abortion laws have been liberalized. The rise in the abortion ratios that has occurred in these countries over time is a result both of an actual increase in the number of abortions performed (the numerator of the ratio) and partly due to the decrease in births (the denominator). The numbers and/or ratios may have begun to drop slightly or to level off since the mid-sixties, but not enough information is available as yet to be certain about the most recent trends.

The number of abortions and the abortion ratios for three countries which have liberalized abortion laws are given in Table 18. Sweden is representative of the Scandinavian countries, where the indications for which abortion is allowable are fairly strict. In Japan, where abortion has been available virtually on demand since 1948, the number of abortions performed each year has remained high, although there seems to be a downward trend since the late 1950's. For Hungary, some statistics are available even before the liberalization of the abortion law in 1956, so the dramatic and steady increase in the performance of abortions since liberalization is very evident. It is interesting to note that since 1958 there have been more abortions than live births recorded in Hungary.

There are great variations in the estimates of illegal abortions in countries which have restrictive abortion laws; figures quoted for the United States range from 200,000 to 1,200,000.[3] The estimates for European countries vary similarly; for example, estimates for Austria range between 100,000 and 300,000 per year, for Belgium from 35,000 to 200,000, and for the Netherlands from 2,000 to 30,000.[4]

INCIDENCE OF ABORTION IN DEVELOPING COUNTRIES

Studies of abortion in countries in which the laws are quite stringent are generally based either on surveys of patients of a particular clinic or in a particular area or on hospital statistics which show the number of women admitted with incomplete abortions or with complications from illegally induced abortions. Such studies are obviously subject to many shortcomings; nevertheless, in order to give a somewhat better indication of the actual incidence of abortion than is offered by wide-ranging estimates, examples of studies in selected areas are summarized below.

Chile is one country in which abortion has been found to have importance as a method of fertility control. In a 1962 study of women in urban Santiago, it was found that one of every four pregnancies among

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[3] Mary Steichen Calderone, ed., *Abortion in the United States* (New York: Harper and Brothers, 1958).

[4] Pierre O. Hubinont, Théo Brat, Jan Polderman, and Ravi Ramdoyal, "Abortion in Western Europe," in Hall, Vol. I, pp. 325-37.

TABLE 18

Number of Abortions and Ratio (Per 1,000 Live Births) in Selected Countries

Year	Japan (1948)[1]		Hungary[2] (1956)		Sweden (1938)	
	Number	Ratio	Number	Ratio	Number	Ratio
1949	246,104	91.2	33,200	174.4	5,503	45
1950	489,111	209.2	36,000	184.0	5,889	51
1951	638,350	298.6	37,800	198.3	6,328	57
1952	798,193	398.0	43,700	235.2	5,322	48
1953	1,068,066	571.7	42,700	206.4	4,915	45
1954	1,143,059	645.9	58,300	261.1	5,089	48
1955	1,170,143	676.1	78,500	373.1	4,562	43
1956	1,159,288	696.1	123,600	641.1	3,851	36
1957	1,122,316	716.3	162,900	974.3	3,386	32
1958	1,128,231	682.3	183,000	1,155.3	2,823	27
1959	1,098,853	675.7	187,700	1,241.4	3,071	29
1960	1,063,256	662.0	196,000	1,337.9	2,792	27
1961	1,035,329	651.4	203,700	1,450.9	2,909	28
1962	985,351	608.4	197,600	1,518.8	3,205	30
1963	955,092	575.5	207,900	1,571.4	3,528	31
1964	878,748	511.8	218,700	1,655.6	4,671	38
1965	843,248	462.3	214,000	1,609.0	6,245	51

[1] Dates indicate year liberal law was first enacted; some of these laws have since been made more liberal.
[2] Includes legal abortions plus hospital admissions for other abortions.

SOURCES: *Japan:* Calculations of ratios were based on number of reported abortions from Minoru Muramatsu, "Abortion in Japan," in Robert E. Hall, ed., *Abortion in a Changing World* (New York: Columbia Univ. Press, 1970), Vol. I, p. 262; number of live births from *Demographic Yearbooks, 1959, 1963, 1964,* and *1967* (New York: United Nations).
Hungary: Calculations of ratios based on data from Christopher Tietze, "Induced Abortion and Sterilization as Methods of Fertility Control," *Journal of Chronic Diseases 18* (1965): 1161-71 for 1949-62; and Christopher Tietze, "Abortion in Europe," *American Journal of Public Health 57* (1967): 1923-32 for 1963-65.
Sweden: Tietze, "Abortion in Europe," *ibid.*

married women and one of every three in broken and common law homes ended in abortion.[5] That the number of abortions has increased over time is shown by official statistics cited by Armijo and Monreal; these statistics, derived from hospitalized abortion cases, showed an increase from 84 abortions per 1,000 live births in 1937 to 204 abortions per 1,000 live births in 1964.[6] A CELADE (Centro Latinoamericano de Demographia) study of abortion in several major Latin American cities showed that the ratio of abortions per 1,000 live births ranged from a low of 130 in Bogotá to a high of 333 in Buenos Aires.[7]

In India, a study by Agarwala of 5,912 women visiting New Delhi family planning clinics reported an average abortion ratio of 90 per 1,000 pregnancies,[8] while the Indian Ministry of Health and Family Planning estimated in 1966 that the total annual number of induced abortions is around five million.[9]

A nationwide survey in Turkey which has been cited by Fişek showed that there were about 250,000 abortions in Turkey during 1967. The abortion rate rose with size of the community, attaining a high of 560 abortions per 1,000 live births in three metropolitan areas. It was also found that among women over 30 years of age there was an average of 1.1 to 1.5 abortions for every live birth.[10] Fişek has also reported a study of 3,068 currently married fertile women up to 44 years of age which indicated that there were 165,000 abortions performed in Turkey annually — a ratio of 160 induced abortions per 1,000 live births.[11]

Finally, two studies in Alexandria governorate of the United Arab Republic, one of nearly 4,000 rural women[12] and one of more than

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[5] L. Tabah and R. Samuel, "Preliminary Findings of a Survey on Fertility and Attitudes Toward Family Formation in Santiago, Chile," in Clyde V. Kiser, ed., *Research in Family Planning* (Princeton, N.J.: Princeton Univ. Press, 1962), pp. 263-304.

[6] Rolando Armijo and Mariano Requena, "Epidemiological Aspects of Abortion" (San Francisco: paper presented at a meeting of the American Public Health Association, 1966).

[7] Calculated from data in Mariano Requena, "The Problem of Induced Abortion in Latin America," *Demography* 5 (1968): 785-98.

[8] S. N. Agarwala, "Abortion Rate Among a Section of Delhi's Population," *Med. Digest 30* (1962): 1, summarized in Gunnar K. af Geijerstam, ed., *An Annotated Bibliography of Induced Abortion* (Ann Arbor, Mich.: Center for Population Planning, 1969), p. 325.

[9] Ministry of Health and Family Planning, *Report of the Committee to Study the Question of Legalization of Abortion* (New Delhi, 1966), quoted by S. Chandrasekhar, "Abortion in India," in Hall, Vol. I, p. 245.

[10] Nusret H. Fişek in Hall, Vol. I, p. 353.

[11] Nusret H. Fişek, "An Epidemiological Study on Abortion in Turkey" (Beirut, Lebanon: paper presented at an International Planned Parenthood Federation Conference, 1971).

[12] W. H. Kamel, A. T. Hanna, M. H. Wahdan, and N. M. Kamel, "A Fertility Study in Al-Amria," *Egyptian Population and Family Planning Review 1* (1968): 83-100.

2,500 married female teachers[13] reported, respectively, 77 and 200 abortions per 1,000 live births.

MEDICAL SEQUELAE OF ABORTION—LEGAL AND ILLEGAL

Spontaneous abortion is an important health problem and is variously estimated to occur in from 10 to 20 percent of all pregnancies; it is believed to be caused most often by abnormalities in development which result from defective germ plasm or from some defect in the uterine environment. The latter may be caused by severe maternal disease, by endocrine imbalance, by psychological trauma, or by radiation or drugs. Habitual abortion is generally defined as three or more consecutive spontaneous abortions. The most common complications of spontaneous abortion are hemorrhage and infection. In some cases abortion is not complete and surgical intervention may be necessary to complete evacuation of the uterus.[14]

As a health problem, and one that is largely preventable, induced abortion is far more important than spontaneous abortion, however. In illegal abortions which are self-induced or induced by untrained individuals, the means include insertion of crude instruments into the uterus, internal use of supposed abortifacients (which may cause considerable damage to the woman), or injection of fluid into the uterus. Such illegal abortions are frequently carried out in very unsanitary surroundings, with no facilities for dealing with emergencies; thus the risk of infection is greater as are the consequences of profuse hemorrhage. Needless to say, such illegal abortions carry a high risk for the woman.

Medical abortions up to about the twelfth week of pregnancy are generally performed vaginally by dilating the cervix and either scraping the uterus with a curette or evacuating it with a vacuum aspirator. For more advanced pregnancies, a hypertonic solution may be injected into the uterus to induce labor or a hysterotomy may be performed. More recently, new abortifacient drugs such as prostaglandin have been under evaluation. The danger inherent in medical abortions is not great since they are performed by medically trained personnel in aseptic conditions, and with the facilities to provide rapid treatment of complications if they develop. However, it must be remembered that no operation is without hazard.

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[13] Torben B. Larsen, "Estimates of Induced Abortion in Certain Middle East Countries" (Beirut, Lebanon: paper presented at an International Planned Parenthood Federation Conference, 1971).

[14] See Nicholson J. Eastman and Louis M. Hellman, *Williams Obstetrics* (13th ed., New York: Appleton-Century-Crofts, 1966), Chapter 21, "Abortion and Premature Labor," pp. 502-40 and Chapter 41, "Artificial Termination of Pregnancy, Sterilization, and Contraception," pp. 1058-62.

Complications of illegal and medical abortions fall into the same categories, but are much more likely and invariably more serious for illegal abortions. The most frequent complications fall into the categories of infection, hemorrhage, and mechanical injuries; examples of less frequent but very serious complications are acute renal failure and the formation of a thromboembolism. Unfortunately, studies of complications associated with abortion, drawn for the most part from countries with liberal abortion laws or from cases of women hospitalized after abortions had been illegally initiated, can only indicate the complications associated with abortion and cannot begin to give a true picture of their incidence; it is also unfortunate that few — if any — such studies are comparable to each other because of variations in such factors as sampling and definition of complications.

However, some generalizations can be drawn by comparing findings from various countries and from individual studies which extend over a period of years or for which the sample size is reasonably large. The least danger of mortality or morbidity as a result of abortion seems to occur for healthy women who are aborted early in pregnancy by physicians who perform the operation frequently and are therefore experienced and who work in aseptic medical facilities where the means of dealing with emergencies as they arise are readily available. If a woman's health is poor, if physicians are inexperienced at performing abortion, or if the pregnancy has advanced beyond the first trimester, the risk of complications becomes greater.[15]

Before Hungary legalized abortion, 80 to 100 women of an estimated 100,000 who had illegal abortions died annually. Deaths from legal abortions in Hungary are now about two or three annually; complications are also at a minimum, according to data for 1964 reported by Klinger.[16] Of the 184,400 legal abortions performed in Hungary in 1964, there were 232 cases (0.13 percent) of perforation of the uterus; 691 cases (0.37 percent) of fever, and 1,141 cases (0.62 percent) of hemorrhage. A total of 2,751 women (1.49 percent) received repeated hospital treatment within four weeks of the abortion for some complication.

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[15] D. M. Potts, "Termination of Pregnancy," *British Medical Bulletin* 26 (1970): 65-71 and "Postconceptive Control of Fertility," *International Journal of Gynaecology and Obstetrics* 8 (1970): 957-70.

[16] Andras Klinger, "Abortion Programs," in Bernard Berelson, Richmond K. Anderson, Oscar Harkavy, John Maier, W. Parker Mauldin, and Sheldon J. Segal, eds., *Family Planning and Population Programs: A Review of World Developments* (Chicago: Univ. of Chicago Press, 1966), pp. 465-76.

In Scandinavia, complications — even of legal abortion — are more frequent than in eastern European countries, because in the latter, abortion is almost always performed during the first three months of gestation, whereas in the northern countries delays in the approval of the abortion may mean that a woman is several months pregnant before the operation is performed. Kolstad, reporting on abortions over a thirteen-year period in one Norwegian hospital, found no cases of complications for abortions (a total of 452) performed in the first month of pregnancy; he reported 5.2, 16.0, 26.7, and 25.0 percent, respectively, for the second through the fifth months.[17] The likelihood that complications will ensue is also increased when sterilization is performed at the same time as the abortion. Of 712 operations, Kolstad reported complications in 10.3 percent of the cases, with serious complications in 2.7 percent of the total. Examples of complications were 20 cases of fever (2.8 percent), 24 of hemorrhage (3.3 percent), of which ten were "serious," and six perforations of the uterus (0.8 percent), three of which were serious.

In one of the few studies of long-term somatic complications of abortion, Lindahl used a sample of 1,188 abortions performed in six Stockholm hospitals between April 1952 and May 1953.[18] Case records were used to determine pregnancy and medical histories and immediate post-operative complications; there were 32 cases (2.69 percent) of hemorrhage, 21 (1.76 percent) of infection, one death, and one perforated uterus. At a three-week post-operative follow-up, 1,133 of the women were examined by gynecologists at the hospital where they had been operated on; 10.76 percent of these women had some infectious or complicating condition, but some of these had existed prior to the performance of the legal abortion. Finally, Lindahl himself examined 1,013 of the women from one to five years after the operation. All were given a gynecologic examination, and some had hysterosalpingography and endometrial biopsies as well. Lindahl found only one case of lasting involuntary sterility among the follow-up patients; the most widespread problem attributable to abortion was endometriosis found in scars in the vaginal wall and occasionally in the uterus and bladder; it occurred in 19.8 percent of 840 patients who had had vaginal hysterotomies. Some changes in the uterine walls were found which may have been due to the operation; however, few if any lasting changes occurred in the fallopian tubes or the ovaries. Subsequent pregnancies could not be shown to have been affected by the earlier abortion.

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[17] Per Kolstad, "Therapeutic Abortion: A Clinical Study Based Upon 968 Cases from a Norwegian Hospital, 1940-53," *Acta Obstetricia et Gynecologica Scandinavica 36,* Supplement 6 (1957): 7-72.

[18] Jan Lindahl, *Somatic Complications Following Legal Abortion* (Stockholm: Scandinavian University Books, 1959).

MORTALITY AS AN INDICATOR OF ABORTION SAFETY

Since reports of complications resulting from abortion are spotty even from countries with liberal abortion laws, the proportion of maternal mortality attributable to abortion must often be used as an index of the severity of abortion as a medical problem. Available mortality statistics indicate that abortion has become increasingly safer in countries in which abortion is legal; there are, however, some revealing differences in the case fatality rates from country to country. For example, the case fatality rate in Sweden for 1935-47 was 0.59 percent;[19] by 1954-59 it had dropped to 0.066 percent, and by 1960-66 it was 0.039 percent.[20] (Similarly, rates for Denmark and Finland in the 1950's were 0.068 and 0.066 percent, respectively.) Low as these rates are, however, case fatality rates are even lower in eastern Europe and Japan, ranging from no deaths at all in Hungary in 1967[21] and Czechoslovakia for 1963-64[22] up to 0.0041 percent for Japan for 1959-63[23] and 0.0057 for Slovenia, Yugoslavia, in the period 1961-67.[24]

Hungary provides a good example of the difference in risk between legal and illegal abortion. Klinger states that of an estimated 100,000 women who had illegal abortions each year in Hungary before the abortion law was liberalized, 80 to 100 died.[25] Deaths from legal abortions in Hungary are now about two or three annually (with no deaths at all reported for 1967), although 20 or more women die each year from spontaneous or illegally induced abortions.

In the United Kingdom, the Council of the Royal College of Obstetricians and Gynaecologists reported in 1966 that, in general, the risks of criminal (and self-induced) abortions — which the Council estimated at 250,000 per year — are high and that many of these cases result in hospital treatment. On the other hand, of the 2,800 therapeutic abortions performed in National Health Service Hospitals in 1962, only four deaths were registered, a case fatality rate of 0.143 percent.[26] The first indications were that since liberalization of the British abortion law in 1967, the rate might drop even lower.[27]

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[19] A. Sjovall, "Abortion and Sterilization in Sweden" (Ger.), *Arch. Gynack. 180* (1951): 324, summarized in Geijerstam, p. 311.

[20] Christopher Tietze, "Induced Abortion as a Method of Fertility Control," in S. J. Behrman, Leslie Corsa, and Ronald Freedman, eds., *Fertility and Family Planning: A World View* (Ann Arbor, Mich.: Univ. of Michigan Press, 1969), p. 322.

[21] I. Hirschler, "The Situation of Abortion in Hungary" (Ger.) in K. H. Mehlan, ed., *Internationale Abortsituation, Abortbekampfung, Antikonzeption* (Leipzig: Georg Thieme, 1961), summarized in Geijerstam, p. 294.

[22] K. H. Mehlan, "The Socialist Countries of Europe," in Berelson *et al.*, pp. 207-26.

[23] Tietze, "Induced Abortion as a Method of Fertility Control," p. 323.

[24] Franc Novak in Peter Diggory, "Abortion and Mortality," in Hall, Vol. II, p. 124.

[25] Klinger, pp. 465-76.

For the most part, for countries where abortion is illegal under all or most circumstances, case fatality rates cannot even be estimated since the number of abortion cases is not known. Mehlan states, however, that illegal abortion is the world's leading cause of maternal mortality, accounting for 30 to 50 percent, and that in Latin America maternal mortality is four times that in countries where abortion is legal.[28] More specifically, Armijo and Monreal estimated that about 39 percent of maternal mortality in Chile in 1963 was attributable to abortion.[29]

Studies in California and New York (two states that have recently liberalized their abortion laws) report that abortion accounted for a high percentage of maternal deaths. Fox's study of abortion deaths in California revealed that between 1957 and 1965 deaths from abortion accounted for about 21 percent of maternal mortality.[30] Gold and colleagues in a study of abortion deaths in New York City found that the percent of all puerperal deaths due to abortion rose from 26.1 percent in 1951-53 to 42.1 percent in 1960-62; the percentage of deaths due to abortion among nonwhites and Puerto Ricans was even higher.[31]

SOCIAL AND PSYCHIATRIC PROBLEMS ASSOCIATED WITH ABORTION

The psychiatric problems associated with requested abortions can be divided into three groups: complications resulting from the performance of the abortion; complications in women who are refused abortions; and complications that appear in the children of unwanted pregnancies. There is only minimal evidence in each of these areas, but since the psychiatric complications associated with abortion can have serious long-term effects, there is a growing interest in studying these problems.

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[26] "Legalized Abortion: Report by the Council of the Royal College of Obstetricians and Gynaecologists," *British Medical Journal 1* (1966): 850-54.

[27] See Diggory, p. 119.

[28] Mehlan, quoted in Milton Helpern, "Abortion and Public Health," in Hall, Vol. II, p. 45.

[29] Rolando Armijo and Tegualda Monreal, "The Problem of Induced Abortion in Chile," *Milbank Memorial Fund Quarterly 43* (October 1965, Part 2): 263.

[30] Leon P. Fox, "Abortion Deaths in California," *American Journal of Obstetrics and Gynecology 98* (1967): 645-53.

[31] Edwin M. Gold, Carl L. Erhardt, Harold Jacobziner, and Frieda G. Nelson, "Therapeutic Abortions in New York City: A 20-Year Review," *American Journal of Public Health 55* (1965): 964-72.

It may be that just as hospital abortions carry minimal medical risks if the woman is in good health as compared to abortions by "unskilled hands under unsanitary conditions," so abortions performed in hospitals under psychologically supportive conditions may carry little psychiatric danger, if the mother's mental health is basically sound, as compared to illegal abortions conducted furtively, demeaningly, and guiltily. Just as the physician performing an abortion must be prepared to treat his patient for physical complications, perhaps psychiatric counseling should routinely be available to counteract psychiatric complications.

In their review of the literature on "Psychiatric Sequelae of Abortion," Simon and Senturia found that the quality of most studies was poor.[32] Samples were often small and self-selected; the precise nature of post-abortal psychiatric "complications" often were not specified; time and method of follow-up were sometimes not clear; frequently women's psychiatric conditions prior to the abortion were not known; and in some studies, no distinction was made between women who had had spontaneous abortions and those who had had induced abortions.

In many studies of varying degrees of reliability, it has been reported that mild and for the most part transitory feelings of guilt are not uncommon following abortion.[33] Evidence of more severe and long-term psychiatric complications is uncertain. Factors which may affect both short- and long-term complications include the state of a woman's mental health before the abortion, the extent to which her choice to be aborted is freely made, and the conditions under which the operation is performed.

Perhaps the best data on psychiatric complications of abortion come from Scandinavian countries; however, even these data are sparse and often contradictory. In a sample of 34 "representative members" of a group of 187 Norwegian women who had had therapeutic abortions, 94 percent were reported by Brekke to have "no emotional disturbance," while the remaining six percent experienced "slight, transient guilt."[34] Kolstad, also writing on Norwegian experience, states that of 968 cases of abortion performed in one hospital between 1940 and 1953, 135 patients reported on their mental reactions to the operation.[35] Of these, nearly 83 percent reported that they were "glad, without reserve" that the operation had been performed; of the remaining 17 percent, nearly four percent were repentent, while the rest were "satisfied but doubtful" or unhappy about the operation but reconciled to its necessity at the time it was performed. In contrast, Malmfors in Sweden reported that of 84 women he had studied, 45 — or more than 50 percent — evinced some degree of unhappiness about their abortions; among these women were ten who had severe feelings of guilt or depression one year after the operation. Thirty-nine of the 84 women were grateful for the abortion.[36]

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[32] Nathan M. Simon and Audrey G. Senturia, "Psychiatric Sequelae of Abortion: Review of the Literature, 1935-1964," *Archives of General Psychiatry* 15 (1966): 378-89.

[33] For review of the literature on psychiatric complications following abortion, see *ibid.;* Robert B. White, "Induced Abortions: A Survey of Their Psychiatric Implications, Complications, and Indications," *Texas Reports on Biology and Medicine* 24 (1966): 532-58; and George S. Walter, "Psychologic and Emotional Consequences of Elective Abortion," *Obstetrics and Gynecology* 36 (1970): 482-91.

In Stockholm, Ekblad did a study in 1951 of 110 of 113 women who had had therapeutic abortions in 1949 for psychiatric indications; the author personally examined the patients both before the termination and during the follow-up period, and an intelligence test was also administered.[37] When the women were questioned as to whether they had had feelings of regret or self-reproach following the abortion, 79 percent responded that they had felt only relief and had had no regret or mental trouble. Twenty-one percent admitted self-reproach or regret at one time or another; however, in ten of these 23 women, these feelings had been of short duration, while the 13 remaining still had periodic or continual sentiments of self-reproach. Ekblad stated that these feelings seemed to be more common among women with higher intelligence than among those of average or sub-average intelligence. Thus, the author found that although an abortion may cause feelings of guilt and regret in many women, it is infrequent that these feelings result in mental illness or reduce the patient's working capacity. That the three percent of his cases where this did occur had all had neurotic tendencies prior to the termination led the author to conclude that mentally well-balanced women seem to be more capable of withstanding the mental strain caused by a legal abortion.

Arens in 1958 interviewed 100 women who had had legal abortions approximately three years earlier for a variety of indications.[38] Fourteen of the 100 had subsequently become pregnant again in order to have a child to substitute for the one which had been aborted. Severe guilt was felt by 23 percent and mild guilt by 25 percent. Because of such symptoms as insomnia, decreased work capacity, and nervousness which were experienced by the women who felt severe guilt, the author believed that guilt feelings must be considered a serious potential complication of abortion.

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[34] Brekke's study is summarized in White, p. 534.

[35] Kolstad, pp. 59-60.

[36] Malmfors' work is summarized in White, p. 534.

[37] Martin Ekblad, "Psychiatric Follow-up Study of Women After Legal Abortion," *Acta Psychiatrica et Neurologica Scandinavica*, Supplement 80 (1952): 162-67.

[38] Arens' work is summarized in Simon and Senturia, pp. 383-84.

There are even fewer data from countries where the abortion laws are more restrictive than they are in the Scandinavian countries; in the United States, for example, those women who have had hospital abortions and are therefore available for study generally have some physical or mental disorder to start with and upon which grounds they were granted a therapeutic abortion. One study of such women was done by Simon and his colleagues in St. Louis; using interviews, questionnaires, the MMPI, and Loevinger Family Problems Scale as measures, they studied 46 of a total of 65 women who had had therapeutic abortions in one hospital between 1955 and 1964.[39] Their findings were reported as follows:

> We concluded from our data that first, women who come to therapeutic abortion are highly selected in terms of their psychopathology. The high incidence of sadomasochism, depression, and rejection of feminine biological role supports this. Second, psychologically healthier women experienced mild, transient depression and conscious feelings of guilt. Third, serious psychiatric illness following abortion was related to the pre-existing psychiatric illness and only rarely related to or precipitated by the abortion. A large number of women who were seriously disturbed before the abortion responded to the procedure well and improved following it.[40]

In preliminary reports from states in the United States where abortion laws have recently been liberalized, the results of therapeutic abortions are generally favorable. For example, Marder reports that 147 patients were treated in one California hospital under the new law and that "Concern and proper care for these patients minimized the development of guilt, remorse, and depression; they generally described marked relief of symptoms and reported improvement in their relationships with others, along with improved living situations."[41]

Few attempts have been made to determine the effect upon women of having requests for abortion denied. Höök was able, however, to make a follow-up study of 249 Swedish women whose applications for abortion were refused in 1948; the follow-up period was between seven and twelve years after that time.[42] Of these women, 86 percent continued the pregnancy to term, three percent had spontaneous abortions, and 11 percent had illegal abortions. At the time of follow-up it was determined that 23 percent of the women had adjusted well to the pregnancy; that 53 percent had eventually adjusted but with some difficulty; and that the remainder still exhibited symptoms of disturbance at the time of follow-up. Adjustment was, in general, better among married women and among those who had shown no specific abnormal traits at the time of their application for abortion. At the time of follow-up, of the children born after refused abortion, eleven had died; 59 percent were growing up with both parents; and a total of 69 percent were living with their mothers. Seven percent of the children had been given up permanently for adoption, while some had been cared for by others at least temporarily. In conclusion, Höök says, "When the women's opinion regarding their situation — their attitude — was considered in association with their adjustment at the follow-up, it was found that among those who gave birth to the child 69 per cent had adjusted themselves and were satisfied with their situation. Thirty-one per cent were dissatisfied with their situation in spite of adjustment at the follow-up, or were poorly adjusted."[43]

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[39] Nathan M. Simon, Audrey G. Senturia, and David Rothman, "Psychiatric Illness Following Therapeutic Abortion," *American Journal of Psychiatry 124* (1967): 59-65.

[40] *Ibid.*, p. 65.

[41] Leon Marder, "Psychiatric Experience with a Liberalized Therapeutic Abortion Law," *American Journal of Psychiatry 126* (1970): 1230-36.

Although Höök mentions that the children whose mothers did not adjust well after an abortion had been refused were presumably growing up under poor or stressful circumstances, the best study of this matter is that by Forssman and Thuwe.[44] These researchers, also working in Sweden, did a careful search of all relevant records for 120 children 21 years after their mothers had been refused abortions. The original sample of women consisted of all those who had applied to the Department of Psychiatry of one Swedish hospital for abortion and been refused. All but three of these women were traced, and of the 194 women (196 pregnancies, since two women had applied twice for abortion), 68 ended in spontaneous or induced abortions; the remaining pregnancies resulted in 134 children, 14 of whom died early, leaving 120 for follow-up. The next same-sexed child born or registered after the experimental child in question was used as a matched control. Records analyzed for the study included those of civil and parish registry offices, of child welfare boards, of child-guidance clinics and psychiatric centers, of the central penal registry, of temperance boards and social agencies, of schools, and of the military.

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[42] Kerstin Höök, "Refused Abortion: A Follow-Up Study of 249 Women Whose Applications Were Refused by the National Board of Health in Sweden," *Acta Psychiatrica Scandinavica* 39, Supplement 168 (1963): 1-156.

[43] *Ibid.*, p. 131.

[44] Hans Forssman and Inga Thuwe, "One Hundred and Twenty Children Born After Application for Therapeutic Abortion Refused," *Acta Psychiatrica Scandinavica* 42 (1966): 71-87.

The details of the careful comparative analysis of these records cannot be given here; in general, the authors found no significant differences between the experimental and control groups on the incidence of drunken misconduct, on ineducability or the need for special instruction, or on fitness for military service. They found a greater incidence of psychiatric treatment and of delinquency of "probable significance" among the unwanted children. And they found significant or highly significant differences between the experimental and control subjects in the following areas: more of the unwanted children received some form of public assistance; fewer of the unwanted children had some form of higher education; and finally, 58 (48.3 percent) of the unwanted children were free of all the defects analyzed in the study, while 82 (68.3 percent) of the controls were completely free of them.

MEDICAL COSTS OF ABORTION AND PROSPECTS FOR ATTENUATING THE ABORTION PROBLEM

In addition to the human costs of abortion — particularly illegal abortion — in terms of mortality and morbidity, at least one study has demonstrated that the costs of caring for women who suffer complications from illegal abortion can be quite high. The study, by Plaza and Briones, of abortion as a medical care problem in four general hospitals and four emergency departments in Santiago and in five general hospitals in various provinces in Chile found that in 1960 the Chilean National Health Service spent more than one million dollars on the care of abortion cases.[45] This figure reflects the high cost (sometimes as much as $3,000) of insuring the survival of a single complicated case. In emergency care, abortion cases represented 41.6 percent of all admissions; curettage for incomplete abortions represented 35 percent of emergency surgery; and abortion cases accounted for 26.7 percent (by volume) of emergency blood transfusions. As compared to care given to women delivering live infants, abortion cases during the same period accounted for 27.3 percent of hospital admissions and 29.4 percent of hospital bed-days.

Given the danger associated with illegal abortions in many places and the cost of dealing with complications, more countries may elect to liberalize their laws so that abortions can be performed under safe, well-regulated conditions. This is what has already happened in Japan and a number of European countries and what is currently happening in many of the states of the United States. However, because many people have philosophical, ethical, or religious objections to abortion and because no operation, however safe, should be performed unnecessarily, effective, acceptable, and widely available contraception is the best way to combat abortion.

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[45] S. Plaza and H. Briones, "El Aborto como problema asistencial," *Rev. Med. Ch. 91* (1963): 294-97, summarized in Armijo and Monreal, pp. 2-3.

Studies conducted in Hungary, Japan, Latin America, and India show that women who resort to abortion — legal or illegal — are frequently highly motivated to limit the size of their families, and that a substantial number of them use abortion as a last resort when contraception has failed.[46] Thus, it is to be hoped that making effective means of contraception widely available will reduce the incidence of induced abortion. Pilot projects which have attempted to reduce abortion through the provision of contraception have met with some success in Japan and in Chile.

One experimental project carried out in six Japanese communities over a five-year period used intensive education and guidance to produce a pronounced drop in both pregnancies and abortions; the success of the program was further enhanced by a simultaneous drop in the birth rate.[47] There were difficulties in the implementation of the project, however, and five full years were required to achieve results that were considered gratifying.

In Chile, where provoked abortion is a serious problem in terms of human and monetary costs, the government has also sought to combat the problem through energetic contraceptive programs. A postpartum and post-abortum IUD insertion program in the western section of Santiago, which included a massive community-wide educational campaign and discussions with women hospitalized in obstetric services, produced some initial successes; after more than three years of operation, 18.5 percent of the estimated 110,000 women of reproductive age had accepted the IUD, and an additional unknown number of women were using contraceptive pills.[48]

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[46] Klinger, p. 469; Yoshio Koya, "Why Induced Abortions in Japan Remain High," in Kiser, pp. 103-10; The Mainichi Newspapers, "The Population Problems Research Council, Summary of Eighth National Survey on Family Planning" (Tokyo: The Mainichi Newspapers, 1965), summarized in Geijerstam, p. 330; M. L. Milanesi, *Induced Abortion* (Port.; University of Sao Paulo; doctoral thesis, 1968), summarized in *ibid.*, p. 256; Mariano Requena, "Social and Economic Correlates of Induced Abortion in Santiago, Chile," *Demography* 2 (1965): 33-49; Agarwala, in Geijerstam, p. 325.

[47] Koya, p. 105.

[48] Benjamin Viel, "Results of a Family Planning Program in the Western Area of the City of Santiago," *American Journal of Public Health* 59 (1969): 1898-1909.

8

THE IMPACT OF CHILDHOOD MORTALITY ON FERTILITY

No matter how persuasive the evidence that many closely spaced pregnancies are harmful to mothers and gradually decrease the likelihood of successful outcome of each subsequent pregnancy; no matter how persuasive the evidence that large family size may contribute to poor health in family members; no matter how persuasive the evidence that children from large families are likely to fare poorly in physical and intellectual development in comparison to children from small families — it is unlikely that parents will consider limiting the size of their families if they have become accustomed to high childhood mortality and expect that some of their children will die no matter what they do. Thus, if the improvement of health is to be used as an incentive for family planning, it is necessary to examine also the ways in which improved health and, particularly, improved childhood survival may be essential to wide acceptance of family planning. The scarcity of studies specifically designed to investigate either the direct or indirect effects of child survival on fertility makes it necessary to analyze overall trends in childhood mortality and fertility and to generate from these observations hypotheses which can be rigorously tested in a variety of sample populations.

HYPOTHESES BASED ON HISTORICAL DATA

Historical studies of the trends in vital rates frequently emphasize the "time-lag" hypothesis of the demographic and epidemiologic transitions; according to this hypothesis, mortality declines typically precede fertility declines by two or three generations.[1] It is further hypothesized that the shift from traditional to modern fertility patterns diffuses gradually — from higher to lower socioeconomic classes, from

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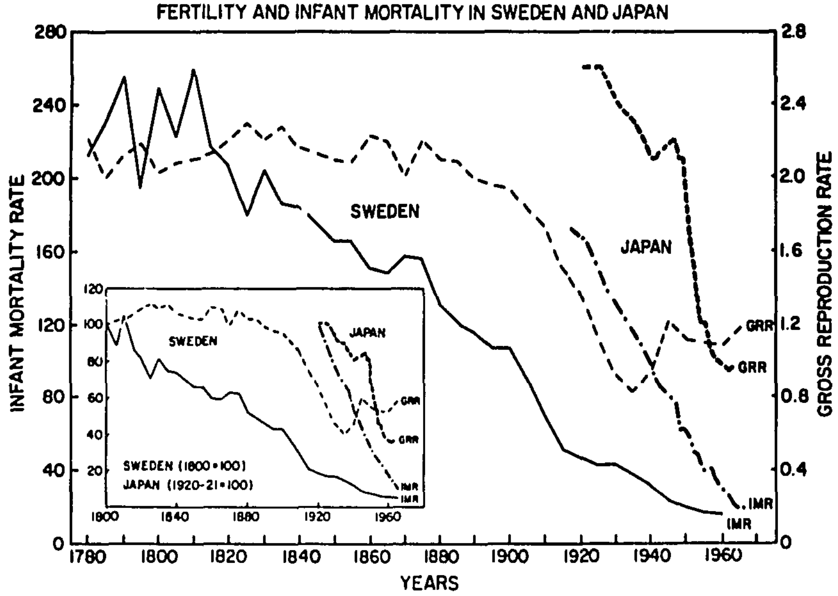
[1] Gösta Carlsson, "The Decline of Fertility: Innovation or Adjustment Process," *Population Studies* 20 (1966): 149-74.

Figure 20. Fertility and infant mortality trends in Sweden and Japan show that fertility declines after a drop in infant mortality. The inset, which sets both the fertility and mortality indicators at 100 for Sweden for 1800 and for Japan for 1920-21, shows the relationship even more clearly. For both countries, the Gross Reproduction Rate is taken as the fertility indicator; for Sweden, infant mortality is indicated by the deaths under one year of age per 1,000 population, while for Japan the more traditional infant mortality rate (deaths under one year per 1,000 live births) was used.



SOURCES: *Sweden:* Drawn from data in Nathan Keyfitz and Wilhelm Flieger, *World Population: An Analysis of Vital Data* (Chicago: Univ. of Chicago Press, 1968).
Japan: Gross Reproduction Rate drawn from data in Irene B. Taeuber, *The Population of Japan* (Princeton, N.J.: Princeton Univ. Press, 1958), p. 312 (1920-55) and Keyfitz and Flieger (1956-63). Infant mortality rates drawn from data in "Fetal, Infant and Early Childhood Mortality," *United Nations Population Study,* No. 13 (1953): Table II, p. 81 (1915-49); Taeuber, Chapter XIV (1947-55); *Demographic Yearbooks, 1963, 1964,* and *1967* (New York: United Nations; data for 1956-61, 1964-66); and Keyfitz and Flieger (1962-63).

more developed to less developed countries — as motives for lowering fertility and adjusting reproductive behavior to changing environmental conditions spread and gain momentum.

The time-lag hypothesis can be supported by longitudinal data from several developed countries; data for Sweden from 1780 to 1965, which are presented in Figure 20, indicate the close interaction between fertility (as measured by the Gross Reproduction Rate) and infant mortality (as measured by deaths in the first year of life per 1,000 population). These data have been standardized in the figure inset so that both fertility and infant mortality equal 100 for 1800; these indexed data show even more clearly the tendency of fertility to decline following a drop in childhood mortality. This tendency is all the more apparent for Japan, where an accelerated transition to modern fertility patterns occurred within a comparatively short period.

The time-lag hypothesis is explained at least in part by the assumption that in the early stages of transition from traditional to modern mortality and fertility patterns, people tend to overcompensate with many births for expected infant and childhood deaths (the overcompensation hypothesis). That is, parents have more children than they actually want because, based on their own previous experience or on the general experience in the community with childhood mortality, they expect that some of their children will die.

Mortality among infants and children declines fairly rapidly, especially in the early stages of the mortality transition; nevertheless, the recognition of this decline may be slow, and it is only after a time-lag (of even a generation or two in western countries) that parents no longer feel the need to compensate in advance for expected childhood deaths. Furthermore, improvements in child survival and reductions in fertility diffuse gradually during the modernization process and demonstrate something of a "cohort effect" as progressively larger segments of a population adopt modern values and ways of living, experience less child mortality, and bear fewer children.

Family formation objectives (including ideal family size, desired number of male and female offspring, and the desired interval between consecutive births) constitute a dimension of fertility which may be influenced by childhood mortality. The experience of losing one or more children may provoke changes in family formation objectives or, if not in the objectives themselves, in the behavior directed at fulfilling the objectives. The experience of losing a son, for example, may put a higher premium on male offspring so that an original objective of having two sons is transposed into a desire for three or more sons.

Evidence to support the assumption that a couple's reproductive behavior and goals may be strongly influenced by their experience or expectations of child deaths can be drawn from empirical data and from theoretical models. Before turning to this evidence, let us note that although sophisticated scientific investigation in this field is comparatively recent, a close relationship between declines in childhood mortality and fertility has long been suspected, as indicated by such nineteenth-century writers as Wappäus and Geissler.[2] Wappäus pointed out in 1859 that parents will only begin to think of limiting the number of their children once their first, second, and perhaps third children have survived the first years of childhood. Arthur Geissler by 1885 provided empirical support for the hypothesis that better childhood survival has a fertility-limiting effect; he investigated miners' families and found that lower fertility could probably result when more children were surviving and being raised to maturity; each child thus being raised to maturity, he felt, lengthened the interval before the birth of another.

INFLUENCE OF CHILDHOOD MORTALITY ON FERTILITY: THEORETICAL MODELS

An interesting assessment of the effects of child survival chances on family formation objectives is offered by David Heer and his associates. Using simulation models which predict reproductive and population characteristics under changing mortality conditions, Heer explored the effects of son survivorship on fertility, given the following assumptions: (1) Each couple "wants" and continues to have children until they are 95 percent certain that at least one son will survive until the father reaches the age of 65; and (2) each couple practices completely effective fertility control once the family formation objective (i.e., 95 percent certainty of son survival) is achieved.[3]

From the calculations presented in Table 19, it can be seen that when the chances of child survival are low, the percentage of couples who could never achieve the objective of a surviving son would be extremely high — despite unlimited reproductive behavior and the resultant high rates of fertility and population increase. Only at life expectancy level 60 does the number of male births required to assure (at the .95 level) the survival of at least one son approach more reasonable levels and become conducive to fertility limitation and reduced rates of population increase.

In a subsequent article, David May, in collaboration with Heer, substituted vital statistics data from India for the period 1951-61 for

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[2] The work of Wappäus and Geissler is discussed in D. E. C. Eversley, *Social Theories of Fertility and the Malthusian Debate* (Oxford: Clarendon Press, 1959), pp. 201-2.

[3] David M. Heer, "Births Necessary to Assure Desired Survivorship of Sons Under Differing Mortality Conditions" (New York: paper presented to the Population Association of America, 1966); see also David M. Heer and Dean O. Smith, "Mortality Level, Desired Family Size, and Population Increase," *Demography* 5 (1968): 104-21 and "Mortality Level, Desired Family Size and Population Increase: Further Variations on a Basic Model," *Demography* 6 (1969): 141-49.

TABLE 19

Preliminary Calculations of the Effect of Mortality on Reproduction

Life expectancy at birth in years	Probability of son's death before father's 65th birthday	Number of male births needed for at least one to survive until father is 65	Percentage of wives never bearing needed number of sons	Female net reproduction rate
20	.695	9	91.4	1.75
25	.619	7	57.8	2.13
30	.551	6	35.3	2.39
35	.490	5	17.0	2.46
40	.435	4	6.1	2.32
45	.372	4	6.1	2.55
50	.323	3	1.6	2.13
55	.262	3	1.6	2.28
60.4	.204	2	0.2	1.64
65.8	.137	2	0.2	1.74
70.2	.083	2	0.2	1.81
73.9	.048	1	0.02	0.93

SOURCE: Adapted from David M. Heer, "Births Necessary to Assure Desired Survivorship of Sons Under Differing Mortality Conditions" (New York: paper presented to the Population Association of America, 1966), Table 1.

the United Nations life table data as inputs for the simulation model.[4] At the Indian life expectancy level (which was at that time around 38 for both sexes at birth) and assuming that perfect family planning was achieved after a son's survival was assured, parents would bear an average of 6.3 children. Even here, with a Gross Reproduction Rate of 3.433, a Net Reproduction Rate of 2.046, and a 2.792 percent rate of natural increase, 3.5 percent of the wives would never bear the number of sons needed to assure, with 95 percent confidence, the survival of one on the father's 65th birthday.

While it would be foolish to argue that illiterate people consciously calculate such mathematical probabilities in making decisions about how many pregnancies and births to have, it is interesting to note the close correspondence of the actual marital fertility for India (6.98) and that predicted by the model (6.3). May and Heer conclude that "son survivorship is a practical necessity in India; and . . . it is unlikely that any rural Indian family will practise family planning until son survivorship is assured to a high level. . . . The prerequisite for a solution of the population problem in India is reduction of the family size required to assure son survivorship."[5]

In pointing out again that intermediate death rates under Indian social and cultural conditions lead to large family size and high rates of population growth, the authors urge that "policy makers should try to make the transition from high to low [child] death rates as quickly as possible, minimizing the amount of time spent at intermediate levels."[6] Not only would the drastic drop in childhood mortality mean a shorter period of transitional growth, but, if the improvements in childhood survival were concentrated, the perception among the people of the improvement might more readily tip the scales in favor of family planning practices.

INFLUENCE OF CHILDHOOD MORTALITY ON FERTILITY: EMPIRICAL EVIDENCE

One of the few studies specifically designed to assess the independent influence of child mortality experience on fertility was conducted by Shafick Hassan in Cairo.[7] Based on his findings of fertility differentials among Egyptian women, he concluded that childhood mortality experience has an inflationary effect on both actual and desired family size which is independent of such socioeconomic variables as education, religion, and duration of marriage. Of the native married mothers surveyed in 1963, 44.6 percent reported the death of at least one child; 80 percent of these deaths were of the first three birth orders, and 63 percent occurred during the first four years of marriage. Of the total deaths, 93.7 percent occurred among children less than five years of age, 68.1 percent in infancy, and 25.6 percent in the one to four age group.

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[4] David A. May and David M. Heer, "Son Survivorship Motivation and Family Size in India: A Computer Simulation," *Population Studies* 22 (1968): 199-210.

[5] *Ibid.*, p. 208.

[6] *Ibid.*, p. 209.

[7] Shafick Hassan, *Influence of Child Mortality on Population Growth* (Ann Arbor, Mich.: University Microfilms, 1966).

That the experience with child mortality may lead couples to overshoot their family size objectives is indicated by Table 20. The number of children born per mother in excess of the number desired is demonstrably greater for women at all educational levels who had lost a child. Among illiterate mothers, for example, those with no child death experience had, on the average, only one child in excess of the average desired number of 3.8; in contrast, those who had experienced a child death averaged 4.8 children more than the number desired.

Hassan attempted further to prove that the fertility differential in Egypt between Muslims and Christians can be explained away by mortality experience alone. As shown in Table 21, he found that both child death experience and parity varied inversely with educational level, regardless of marriage duration; this relationship was evident among both Muslim and Christian women. Moreover, when a standard average for educational level was calculated for each of the religious and marital duration sub-groups, the strength of the relationship between parity and child death experience became all the more evident. With regard to ideal family size, a similar relationship linking the number of child deaths with the desire for many children was reported. It can be noted from Figure 21 that the influence of child death experience on desired family size is most apparent among the most recently married women.[8] That is, among the most recently married, those who had experienced no child deaths had the lowest ideal family size — presumably a reflection of their confidence that the children they might bear would survive. Among the recently married who had had a child die, ideal family size was very high — presumably a reflection of their fear that more of their children might die.

Hassan concluded that the frequently observed class differences in parity and desired family size might be better explained in terms of child death experience than in terms of socioeconomic variables. He

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[8] Shafick Hassan, "Religion Versus Child Mortality as a Cause of Differential Fertility" (Cincinnati: paper presented to the Population Association of America, 1967).

TABLE 20

Children in Excess of Desired Number per Mother (Ages 45-49) by Education, Experience with Child Death, and Infant Mortality Rates. Cairo, 1963

		Children born per mother		Children in excess of desired number		
Education of mother	Desired number of children	No child deaths	Child death experience	No child deaths	Child death experience	Infant mortality rates[1]
Illiterate	3.8	4.8	8.6	1.0	4.8	176
Read and write	3.4	4.6	8.1	1.2	4.7	100
Primary	3.6	4.2	6.6	0.6	3.0	94
Secondary	3.1	3.4	5.6	0.3	2.5	58
College	2.8	2.8	3.0	—	0.2	7

[1] Infant mortality rates are derived from the number of children who died under one year of age per 1,000 live births in each educational category.

SOURCE: Shafick Hassan, *Influence of Child Mortality on Population Growth* (Ann Arbor, Mich.: University Microfilms, 1966), Table 6-4, p. 108; reprinted by permission of Dr. Hassan.

TABLE 21

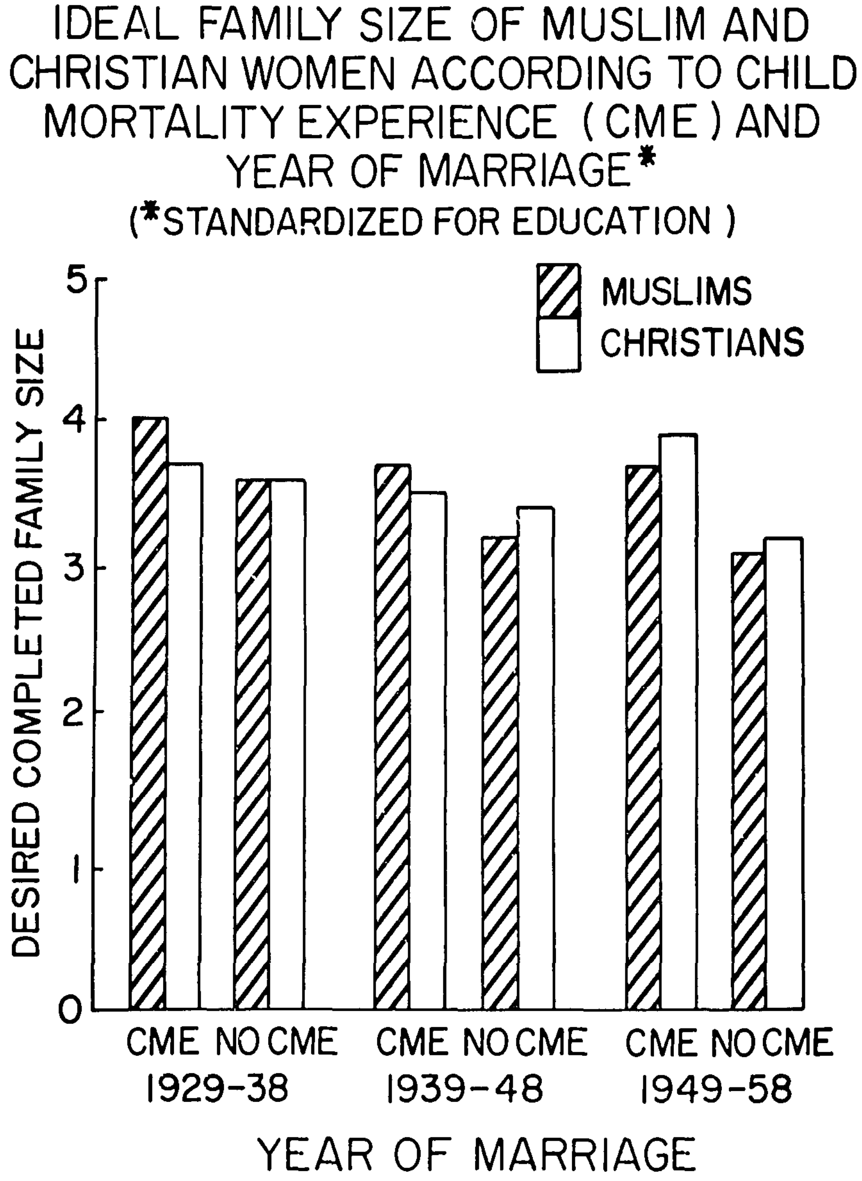
Average Number of Children Ever Born per Mother by Duration of Marriage, Religion, Education, and Number of Child Deaths, Cairo, 1963

Duration of marriage and education	Children ever born per mother							
	Muslims				Christians			
	Number of child deaths				Number of child deaths			
	None	One	Two	Three+	None	One	Two	Three+
5-14 Years marriage								
Illiterate	3.2	4.4	5.0	6.3	3.6	4.3	4.4	7.2
Read and write	3.1	4.1	5.6	6.5	3.1	4.5	4.3	6.0
Primary	2.6	3.2	5.0	7.1	2.5	3.9	6.0	—
Secondary or more	2.1	3.5	7.1	—	2.2	4.0	5.0	—
Standardized average[1]	2.9	3.9	5.4	6.5	3.0	4.2	4.8	6.8
15-24 Years marriage								
Illiterate	4.7	5.9	7.6	8.3	5.5	6.6	7.3	8.4
Read and write	4.4	5.8	7.6	8.7	4.4	5.4	7.0	9.0
Primary	3.1	6.0	6.3	8.0	3.2	5.4	6.5	7.0
Secondary or more	3.3	4.6	—	6.0	3.1	4.3	4.5	—
Standardized average[1]	4.1	5.7	7.2	8.0	4.4	5.7	6.6	8.2
25-34 Years marriage								
Illiterate	5.8	7.1	8.4	10.1	4.5	6.6	7.6	9.5
Read and write	4.6	7.6	8.7	10.1	5.3	6.8	8.2	10.6
Primary	4.1	4.6	5.5	9.3	4.5	4.7	7.5	8.7
Secondary or more	4.4	—	5.7	9.0	2.9	2.0	9.9	—
Standardized average[1]	4.9	6.5	7.4	9.8	4.4	5.5	8.1	9.6

[1] Standardized average controlled for education.

SOURCE: Shafick Hassan, "Religion Versus Mortality as a Cause of Differential Fertility" (Cincinnati: paper presented to the Population Association of America, 1967), Table 4, p. 29; reprinted by permission of Dr. Hassan.

Figure 21. Ideal family size of Muslim and Christian women according to child mortality experience (CME) and year of marriage shows that those who had had a child die had larger ideal family sizes.



SOURCE: Drawn from data in Shafick Hassan, "Religion Versus Child Mortality as a Cause of Differential Fertility" (Cincinnati: paper presented to the Population Association of America, 1967), Table 1, p. 15.

argued that class differences in fertility were largely an artifact of the differential exposure to the risk of child death. It would appear, then, that early experience with child death predisposed bereaved couples to inflate both their actual and ideal fertility performance. Hassan offered the following reasons in support of this thesis: (1) Because child deaths typically came in the early years of family formation, they were perceived as a threat to the family which could only be offset by continued, deliberate efforts to reproduce. (2) By the time the survival of the desired number of children was assured, that is, when about four children had survived the critical first five years, the reproductive period was virtually over. (3) The inability to predict the future survival of children coupled with the pessimistic outlook that prevailed in the immediate environment heightened the psychological or emotional need for many children.

The proposition that childhood mortality experience alone can account for class differentials in fertility was supported by a study by Rele in Uttar Pradesh, India, in the late 1950's.[9] The children ever born and those surviving per woman were compared among the following four "classes": Group I, upper class Hindus, mostly Brahmans; Group II, Hindu castes of intermediate status; Group III, lower Hindu castes and "scheduled" castes; and Group IV, all non-Hindus, most of whom were Muslims. Differences among the four groups were indicated by a number of factors; for example, the male literacy rate was 82, 30, 19, and 36 percent for Groups I through IV, respectively.

Comparison of the mean number of children ever born and of those surviving among the four groups by years of effective marriage duration revealed the virtual absence of class fertility differentials in the early years of marriage, that is, among marriages of less than 15 years' duration. Regarding childhood mortality experience, however, striking differences among the four groups were apparent, particularly in the early years of marriage. As indicated by Table 22, Group IV had unexpectedly low fertility as well as low childhood survival in the first 15 years of marriage; yet it is this same low status group which demonstrated the highest parity (both in terms of children ever born and in terms of children surviving) in the later years of marriage — perhaps to compensate for the children who had died.

Further support for the proposition that low and/or variable chances of child survival may be perceived as a threat to the family formation process comes from several attitudinal surveys. In a study of elites in East Pakistan (for whom the average number of desired offspring was

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[9] J. R. Rele, "Fertility Differentials in India," *Milbank Memorial Fund Quarterly 41* (1963): 183-99.

TABLE 22

Average Parity (Children Ever Born per Woman) and Family Size (Children Surviving per Woman) by Social Class and Marriage Duration, India

	Effective marriage duration less than 15 years			Effective marriage duration 15 years or more		
Class	Parity	Family size	Percentage of children surviving	Parity	Family size	Percentage of children surviving
I	1.74	1.33	76	5.97	3.92	65
II	1.71	1.15	67	6.32	3.81	60
III	1.83	1.24	67	6.44	3.83	59
IV	1.52	1.04	68	7.17	4.21	58

SOURCE: Calculated from data in J. R. Rele, "Fertility Differentials in India," *Milbank Memorial Fund Quarterly 41* (1963): Table 3, p. 190.

3.4), the respondents were asked why they would not consider having fewer children.[10] The overwhelming reason given was "fear of childhood mortality." This reason was indicated by 44 percent of the respondents; only 29 percent listed "preference for male" and "to make a happy home"; and even fewer (17 percent) mentioned "psychological satisfaction." Similarly, among both urban and rural groups in India, where the child survivorship ratio was very low, the threat to family-building posed by child mortality appeared to be at the heart of reasons given by both men and women for wanting additional children.[11] "Assurance of family survival" and "care in old age" seemed particularly important among rural males, of which 93 and 86 percent, respectively, cited these reasons as major motivations for desiring additional children. These responses indicate that concern with child survival is a critical factor impinging upon the family formation process. They further indicate that family formation objectives may not be limited to clear-cut goals for a specific number of children, or specific number of sons, but may also include more generalized objectives, such as the desire for an adequate number of children to provide care and support for aged parents or the desire for a son to preside over the father's funeral rites.

One of the mechanisms by which child mortality may affect fertility is through its impact on the interval before a subsequent birth. The underlying hypothesis is that mothers experiencing a fetal or infant loss tend to compensate for the loss by becoming pregnant sooner than they would have, had the earlier infant survived. This is essentially a corollary of the hypothesis put forth by Geissler in the nineteenth century, and it suggests an interesting area for study. One of the very few studies that have been done in the area is that by Newcombe and Rhynas, who utilized the linkage of birth and infant death records in British Columbia (see Chapter 2) to determine the intervals following stillbirths.[12] They conclude that "Over-compensation is apparent in the first year following the stillbirths, the number of births being about 2.7 times the number that would have been expected if the earlier infants had lived. However, no difference is detected in the second year, while in the third and fourth the observed numbers are only 0.7 and 0.6 of the expected."[13] The authors speculate that the women who replace their loss within the first year are "naturally fertile" and that some of them have a "deliberate intention" to become pregnant again quickly; those who do not replace the loss before the third or fourth year may be those "who have either decided against further attempts at procreation because of the earlier stillbirth, or in whom stillbirth is merely one expression of a physiological infertility." There was no evidence that there was an immediate attempt to compensate for infant loss among a very small sample of women whose infants had died of erythroblastosis.

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[10] Mohammed Habibur Rahman Siddiqui, *Family, Social Engineering, and Population Programs: A Study of Physicians, Government Officials, Lawyers and Professors in Pakistan* (Ann Arbor, Mich.: University Microfilms, 1967), pp. 40 and 76.

[11] "The Mysore Population Study," *Population Studies*, No. 34 (New York: United Nations, 1961), Table 11.17, p. 147.

[12] Howard B. Newcombe and Philip O. W. Rhynas, "Child Spacing Following Stillbirth and Infant Death," *Eugenics Quarterly* 9 (1962): 25-35.

[13] *Ibid.*, pp. 29 and 31.

CHILD SURVIVAL, FAMILY PLANNING PRACTICES, AND FERTILITY

It is axiomatic that fertility reduction presupposes the widespread practice of birth control — contraception, abortion, sterilization, or some combination thereof. From fertility studies in both western and non-western countries, the motivation to control the number of pregnancies or births voluntarily emerges as the most fundamental determinant of fertility differentials. The extent to which actual or perceived excesses in child mortality threaten the process of family formation may significantly alter the level and intensity of family planning motivation. For example, in a traditional society where the ideal family size is four but where the chances of child survival are 50 percent or less, at least eight live births (and, no doubt, an even larger number of pregnancies!) are needed to achieve the desired family size. Thus, it is hardly surprising that traditional environments provide scant motivation to limit or regulate fertility. In fact, under such adverse reproductive conditions, the motivation may well be in the opposite direction — to maximize the probability of surviving progeny by having as many pregnancies "as God permits."

In less developed areas where the mortality risks to infants and young children (as well as to the mother) are still high or, even at best, unpredictable, the notion of family planning can hardly be expected to meet with anything but neglect — if not resistance. In many of these areas, the chance that a child will survive young adulthood hardly ever exceeds 80 percent and frequently falls much lower. Among couples interviewed in central India, for example, those who had had seven children averaged only 4.2 survivors, while those with a parity of nine averaged only five living children at the time of the study.[14] Frustration and uncertainty coupled with the dim prospects for fulfilling family formation objectives would appear to undermine significantly any possible motivation to practice family planning.

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[14] Edwin D. Driver, *Differential Fertility in Central India* (Princeton: Princeton Univ. Press, 1963), Table 91, p. 104.

Hassan's study in Egypt indicated similarly low chances of child survival; his study also showed that child mortality experience is directly related to the postponement of birth control practice until several children have been born, as shown in Table 23. Among both Muslim and Christian mothers who had not experienced a child death, the average parity (controlled for education) before contraceptives were used was 3.2. In striking contrast, the average number of children born to mothers with child death experience before they began to use contraceptives increased steadily with each child death to reach 7.4 and 6.3 among illiterate and literate Muslims and 7.3 and 5.4 among illiterate and literate Christians. The close association between child survival and birth control practice is also evident from a study in Taiwan, for which the basic findings are summarized in Table 24.

The readiness to practice family planning thus seems closely bound to the process of family formation; when this process is threatened by child death, the tendency is to postpone family planning practices until the later reproductive years by which time secondary sterility has alleviated the need and already high parity has nullified the value.

CHILD SURVIVAL, FAMILY FORMATION OBJECTIVES, AND FERTILITY: FURTHER INVESTIGATIONS

Recent demographic trends in less developed countries demonstrate striking deviations from the historical data which provide the basis for the time-lag hypothesis that fertility decline follows mortality declines. Not only is the transition to modern mortality patterns being achieved quite rapidly and dramatically, but also the sudden shift to low mortality levels is being achieved largely as a result of imported medical technology, with only minimal changes in socioeconomic conditions. Thus, the modern infrastructure which helped to shape the rationale for birth control in most western countries (and in Japan's accelerated transition), has yet to mature in less developed areas where lowered mortality has compounded the problem of population pressures without as yet seeming to contribute to a fertility reduction.

Even though it may be reasonable to assume that fertility in transitional societies will follow the western pattern and eventually decline in response to changing mortality and socioeconomic conditions, it is only realistic to recognize that time is running short. It is necessary to achieve an understanding of the stimulus-response mechanisms which

TABLE 23

Average Number of Children Ever Born per Mother Before Use of Contraception, By Child Death Experience, Religion, and Educational Level

Number of child deaths	Muslims			Christians		
	Illiterate	Primary or more	Standardized average[1]	Illiterate	Primary or more	Standardized average[1]
None	4.0	2.5	3.2	3.9	2.6	3.2
One	4.7	3.8	4.1	5.2	4.5	5.0
Two	6.4	5.6	5.9	7.3	5.4	6.0
Three or more	7.4	6.3	7.4	7.3	5.4	6.6

[1] Controlled for education.

SOURCE: Same as Table 21.

TABLE 24

Actual and Desired Family Size as Related to Birth Control Practices Taichung, Taiwan, 1963

Wife's education	Actual family size	Desired family size	Survival rate for children	Percent using birth control[1]
None	4.9	4.4	.86	26
Primary, not graduated	4.7	4.2	.90	48
Primary, graduated	4.8	4.2	.90	51
Jr. or Sr. level, not graduated	4.1	3.6	.91	66
Sr. level or more, graduated	3.4	3.3	.94	76

[1] Any of three methods: abortion, sterilization, and/or contraception.

SOURCE: Abstracted from Ronald Freedman, John Y. Takeshita, and T. H. Sun, "Fertility and Family Planning in Taiwan: A Case Study of the Demographic Transition," *American Journal of Sociology 70* (1964): Table 7, p. 25.

weld together the modern complex of low mortality, low fertility, and high living standards in terms which would indicate how to speed up the adjustment of reproductive behavior to changing environmental conditions and thus cut short the lag period.

Thus, one formidable research question is whether the time lag between improvements in child survival and reduced fertility can be made shorter in the transitional countries than it was in the economically advanced countries if the reductions in childhood mortality are so rapid and dramatic that they are readily perceived. The answer to this question will not be easy to obtain, for to mention only a few of the problems, a research design to test the underlying hypotheses will require a long study period, during which time many uncontrollable variables may be introduced. Furthermore, it is almost impossible to separate the independent variables under examination from the complex of social, cultural, biologic, and administrative variables.

Nevertheless, at least one bold attempt is underway in India to examine this question; it is being conducted by the Johns Hopkins University group under the direction of Carl Taylor.[15] The study aims at testing and evaluating the hypothesis that beliefs about child survival influence the acceptance of family planning; it also seeks to investigate the value of different approaches to providing family planning and maternal and child health care. The research program has been launched in villages in the Punjab, India, with headquarters at Narangwal. The three approaches that will be compared through field investigations and the populations in which they are being carried out are as follows: (1) A firmly established system of child care, including family planning, is operating in 17 villages (total population: 15,262); the main impetus of this program is to improve childhood survival through early detection and treatment of sickness in the community. (2) A system offering "women's services," including family planning, is in operation in nine villages (total population: 9,563). (3) A control area (population 4,443) provides no medical services beyond the family planning normally accessible to a rural community through the government health service.

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[15] Personal communication, through the World Health Organization.

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EVALUATION AND PROSPECTS OF THE HEALTH THEME

Twentieth-century investigations have given the force of new evidence to Charles Knowlton's pioneering argument for improved family health through family planning; this monograph gives a reasonably comprehensive review of the recent literature on the health, development, and adjustment of family members as they may be affected by such family planning variables as family size, inter-pregnancy intervals, maternal age, and family desires and goals. This sampling of studies from different cultures, geographic areas, and disciplines shows that there is compelling evidence of an association between these variables and various problems of health, development, and adjustment.

The nature of the evidence which supports the association between family planning variables and problems of health and adjustment has given the body of this monograph a negative cast. Now in summarizing the evidence briefly and in touching upon a couple of additional topics, let me be more positive in expressing the hope that family planning can have an important part in reducing the risks and problems documented here and in fostering family health and well-being.

1. *Reduction of perinatal and infant mortality:* The evidence of a positive, independent association between parity and perinatal and infant mortality is the best of any of the data presented here because these data are comprehensive and because in many of the studies reporting this association, other competing variables were controlled. Furthermore, evidence of this association comes from a variety of geographical and cultural settings. Mortality was also shown to be influenced by other family planning variables such as maternal age and birth spacing. Thus, family planning programs which help to limit births, to space them wisely, and to facilitate reproduction at the safest maternal ages have the potential for reducing stillbirths and infant mortality among all social groups and in many different areas of

the world. Besides the overall benefits of family planning in this regard, additional attention can be focused on helping to reduce pregnancy wastage in high risk groups. At least two studies have addressed the role that family planning can play in this task; both involve the identification of women with high risk of unsuccessful outcome of pregnancy, and the provision of such women with family planning to prevent future births or to postpone them until the risk of pregnancy wastage has been reduced through medical treatment, improved nutrition, etc. Gold reports that in several of the communities in which comprehensive maternal and infant care programs (including family planning) have been in operation, prematurity, stillbirths, and neonatal mortality have been reduced, and he advocates the extension of such services.[1]

2. *Protection of maternal health:* With but few exceptions, studies of maternal health conclude that increasing parity — particularly to the level of "grand multiparity" — is frequently detrimental to maternal health. In regard to this parameter, the importance of good medical care, as well as of family planning, in securing maternal health can be seen. Several of the studies reported here show that in modern medical facilities, the greater relative risk of mortality for grand multiparas as compared to women of lower parity, has been considerably reduced or eliminated. However, the grand multipara's risk of many obstetric complications and of developing such problems as diabetes remains high. Although good obstetric management keeps these problems from being fatal as often as they once were, family planning can lessen their occurrence by preventing additional pregnancies when they are likely to be detrimental to maternal health.

3. *Benefits of planning the intervals between pregnancies:* The effects of too closely spaced pregnancies have been shown to be manifested most directly in increased mortality risks for the infant. However, it is obvious that perinatal mortality is caused at least in part by poor uterine environment and that infant mortality may be related to poor home environment or maternal care. If a woman has the chance to recover from the stress of one pregnancy, adjust to caring for one new infant, and to prepare for another before becoming pregnant again, the chances of successful outcome for mother and child should be increased. Although it is impossible to define the optimal birth

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[1] Edwin M. Gold and Walter M. Ballard, "The Role of Family Planning in Prevention of Pregnancy Wastage," *Clinical Obstetrics and Gynecology 13* (1970): 145-56; see also Donald V. McCalister, C. Morton Hawkins, and Joseph D. Beasley, "Projected Effects of Family Planning on the Incidence of Perinatal Mortality in a Lower-Class Nonwhite Population," *American Journal of Obstetrics and Gynecology 106* (1970): 573-80.

interval precisely, an interval of at least two years but not too much longer than three years between births seems to be a beneficial range.

4. *Enhancement of family health and adjustment:* The health and happiness of all family members may be influenced by family size, by birth intervals, or by the burden of caring for a handicapped child born after increased maternal age and/or parity has raised the risk of occurrence of such conditions as Down's syndrome. Those problems which have been shown to be closely related to the increased pressure from each additional family member — for example, malnutrition and spread of infections — can obviously be alleviated by keeping family size small. Better health and better nutrition along with more parental attention for few children rather than little attention for many children should help to foster good health and adjustment. The area of marital adjustment is one in which family planning can be shown to have direct potential for favorable influence. The studies on family size and marital happiness show that it is not family size *per se* that influences marital adjustment as much as it is the successful control of fertility according to a couple's desires. Thus, solving the problem of involuntary infertility as well as preventing unwanted births can enhance marital adjustment.

5. *Improvement of children's physical, mental, and emotional growth and development:* Although birth weight seems generally to increase with birth order, the degree to which later-born infants are benefitted is debatable. When height and weight are used as indicators of physical growth and development, children in large families are at a disadvantage compared to those from small families. Similarly, children from large families seem frequently to be at a disadvantage in intellectual development, as measured by intelligence and verbal reasoning tests. The causes of these disadvantages have not been delineated with certainty; however, it seems safe to venture the suggestion that among them may be poorer nutrition for children in large families and less parental care and attention. Since the adequacy of maternal care has been shown to be related to the number and spacing of children, it seems safe to assume that fewer children, adequately spaced through careful use of family planning, will contribute to good maternal care.

6. *Prevention of abortion and unwanted births:* Because the goal of family planning is to give individuals control over their fertility, it should go without saying that one of its important functions is to prevent unwanted births. This goal can be supported by data which show that illegitimate births, which are presumably unwanted, carry

a greater risk of morbidity and mortality for both mother and infant.[2] Furthermore, what little evidence there is on the psychological and social consequences of unwanted births — legitimate and illegitimate — indicates that both the mother who bears an unwanted child and the child himself may be psychologically and/or socially handicapped. Many women seek to prevent unwanted births by obtaining abortions, which may lead to another set of problems. Even under the best circumstances in which abortion is performed legally, by skilled, well-trained medical personnel, in a modern medical facility, there is some danger of medical or emotional complications or even death for the woman. The danger of serious complications is magnified when the operation is performed illegally, by unskilled or untrained personnel using improper methods in an ill-equipped, unsanitary environment. Thus, it seems desirable to prevent abortion whenever feasible, and pilot studies have shown that it is possible to do so through intensive and effective family planning campaigns.

7. *Timing pregnancies at maternal ages of least reproductive risk:* Although a chapter was not devoted to maternal age, it has been discussed throughout this monograph as it relates to other family planning variables, and it is evident that pregnancies at "too young" and "too old" maternal ages increase the likelihood of both maternal and fetal complications. Advanced maternal age, for example, carries greater risk of maternal mortality and of certain abnormalities such as Down's syndrome. As with birth interval, it is not easy to define ideal maternal age, but the consensus points to the ages between 18 and 30. Within that range, however, parity and birth interval are closely related to the determination of optimal maternal age, since high parity at a young age or a first birth at an "old" age carries greater risks than, for example, a third birth at age 28 or 30 which follows a second birth by two or three years. Thus, family planning can help prevent births until the first is wanted, can make possible the wise spacing of desired children and again prevent births once desired family size has been achieved and after a woman has reached an age at which pregnancy carries high risks.

8. *Prevention of hereditary disorders:* One problem which has not been dealt with in detail here, but which family planning can help to

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[2] See, for example, Raymond Illsley, "The Sociological Study of Reproduction and Its Outcome," in Stephen A. Richardson and Alan F. Guttmacher, eds., *Childbearing — Its Social and Psychological Aspects* (Baltimore: Williams and Wilkins Co., 1967), pp. 75-141 and Jean Pakter, Henry J. Rosner, Harold Jacobziner, and Frieda Greenstein, "Out-of-Wedlock Births in New York City: I—Sociological Aspects and II — Medical Aspects," *American Journal of Public Health 51* (1961): 683-96 and 846-65.

alleviate, is the problem of hereditary disorders. With the great advances in genetics in recent years, it is becoming increasingly possible to evaluate the magnitude of the risk of hereditary disorders to the offspring of individual couples and to offer birth control or sterilization if it seems warranted to prevent the birth of potentially defective children.[3]

9. *Contribution to environmental quality:* Although the emphasis in this monograph has been on the health of individual families, there are also areas of concern to be examined with regard to health effects of population pressure that go beyond the family unit. Many problems that are directly or indirectly related to population pressure have great potential for affecting the health of whole communities. For example, the problems of environmental pollution — from industry, from agricultural chemicals, from peaceful as well as military uses of nuclear energy — are being seriously aggravated by growing populations in industrialized and affluent countries. The potentially serious effects of these pollution problems on the health of presently "developed" countries and their future implications for those nations now "developing" need to be recognized as an area of concern for public health workers. Other potentially serious problems hinge on some possible community reactions to the stress of overcrowding suggested by the animal studies reviewed in the appendix. Thus, concern over community health effects of population pressure should be added to the concern over the health of individual families in furthering national family planning programs and population policies.

RESEARCH DIRECTIONS

Scientifically, there are a number of shortcomings in the literature cited here; however, none of these is so significant as to counterbalance the weight of the evidence of an association between family planning and well-being. Unfortunately, the studies of animal populations (see Appendix), which were subject to the most exacting of experimental designs, cannot be extrapolated to man; the overwhelming animal evidence of the adverse effects of crowding must simply be accepted for what it is worth and improvements made in the design and execution of human studies whenever possible.

Urgently needed are carefully designed studies which approach the problems of cause and effect, the way in which the association between family planning variables and family health works, and whether it is directly causal or merely secondary. It is vital that these studies be carried out in a variety of cultural settings, since most of the evidence now available comes from western countries; some such studies have been initiated by the World Health Organization and are being coordinated by the author. These studies represent an important international collaboration among investigators in seven countries: Turkey, Lebanon, Iran, Pakistan, India, Taiwan, and the Philippines. The studies focus on the following:

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[3] For a more complete treatment of this topic, see "Human Genetics and Public Health: Second Report of the WHO Expert Committee on Human Genetics," *World Health Organization Technical Report Series,* No. 282 (1964).

1. The relation between health on the one hand and family size and the tempo of family building on the other: The fundamental question here is the impact on the health of the mother and children in particular, of the size of the family, the number and timing of pregnancies, and maternal age.
2. The relationship of childhood mortality and reproductive patterns: The issue to be examined here is the influence on reproduction of high childhood mortality experienced by people either in their own or in the previous generation.

For the sake of completeness and refinement of our understanding of the problems dealt with in this monograph, it is important to point the direction for new and more carefully controlled research, especially in developing countries. However, the chief purpose of this monograph is to give some indication of the weight of evidence already available to support the health theme as a central part of family planning programs. We have demonstrated that whether or not family planning variables produce ill effects on health and adjustment alone or as part of an equation of poor, crowded homes, low per capita income, and other social and economic variables, the association does exist and is part of a cycle of high fertility, high morbidity, and high mortality.

The evidence should be strong enough for medical and public health professionals to realize their ethical obligation to endorse the planning of families and spacing of children as an integral component of everyday medical practice. Again, as Knowlton said 140 years ago, "it is as much the duty of the physician to inform mankind of the means of preventing the evils that are liable to arise from gratifying the reproductive instinct, as it is to inform them how to keep clear of the gout or the dyspepsia."[4]

The prospects for the health theme to play an important motivational role in family planning programs are good, for the theme is supported by strong conceptual, professional, and cultural rationales growing out of the evidence presented in the earlier chapters of this monograph.

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[4] Charles Knowlton, *Fruits of Philosophy* (Boston: 1833), p. 13.

THE CONCEPTUAL RATIONALE FOR THE HEALTH THEME

The conceptual rationale for the health theme focuses on the premise that health has always been a crucial variable in population dynamics. On the one hand, health is affected by such family planning variables as family size, birth intervals, and maternal age; on the other hand, health improvement within a population can be seen as contributing to the success of a fertility control program. According to this concept, health is actually acting as an intermediate variable which is *dependent* on social and economic change as well as on medical progress and which in turn influences the acceptance of small family norms. For countries which need to make the lag between improved survival and lowered fertility as short as possible, the importance of understanding the dynamics linking reduced childhood mortality and reduced fertility cannot be too strongly stressed.

The dynamic relationship of mortality, fertility, and socioeconomic conditions can be conceptualized schematically as shown in Figure 22. In this diagram, which is a modification of one developed by Walsh McDermott, there is a cyclical flow from one variable to another.[5] The cycle on the left of the diagram shows that the results of sustained high fertility are a population that is demographically young and homes that are crowded with children; such crowded homes are usually associated with poverty, poor nutrition, and poor environmental sanitation. These conditions and a variety of other social and cultural factors produce a pattern of disease which we have used to define the Age of Pestilence and Famine in the epidemiologic transition,[6] a stage which characterized pre-industrial western countries and which presently obtains in a number of developing nations. For children, the most serious condition within this disease pattern is the diarrhea-pneumonia complex. With malnutrition common and with medical care virtually nonexistent or grossly inadequate, infant and childhood

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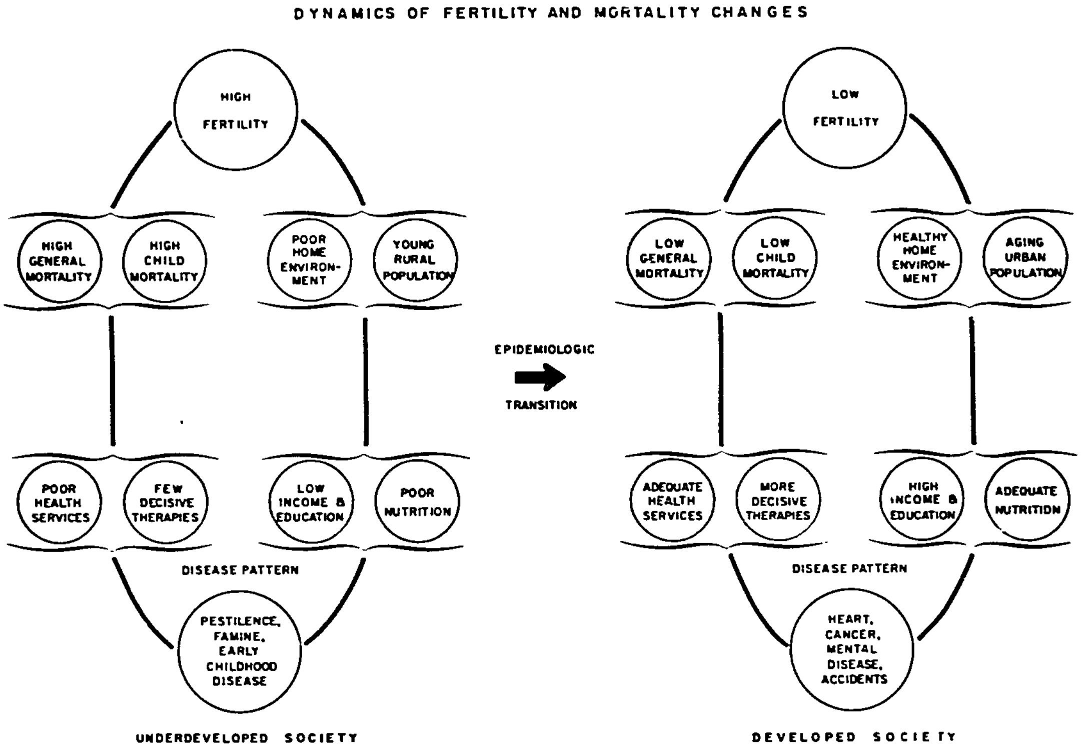
[5] Walsh McDermott, "Modern Medicine and the Demographic-Disease Pattern of Overly Traditional Societies: A Technologic Misfit," *Journal of Medical Education 41* (September 1966, part 2): 137-62.

[6] Conceptually, the "epidemiologic transition" focuses on the complex changes in patterns of health and disease and the interactions between these patterns and their demographic, economic, and social determinants. There can be little doubt that an epidemiologic transition has paralleled the demographic transition in many countries of the world and continues to occur in other places, as degenerative and man-made diseases largely displace pandemics of infection. Briefly, this is a transition from an Age of Pestilence and Famine to an Age of Degenerative and Man-made Diseases, with an Age of Receding Pandemics bridging the intermediate period. This theory was developed by Omran in 1967 and is detailed in Abdel R. Omran, "The Epidemiologic Transition: A Theory of the Epidemiology of Population Change," *Milbank Memorial Fund Quarterly* (October 1971).

Figure 22. These cycles show the dynamics of fertility and mortality change; the pattern characteristic of "underdeveloped" societies is on the left and that characteristic of "developed" societies on the right.



mortality rates are high. In the face of this high mortality, it is hardly conceivable that parents will seriously consider family limitation, especially when high birth rates are reinforced by many other social, cultural, and economic factors which make additional children more an asset than a liability for the parents.

Theoretically, the cycle depicted on the left in Figure 22 can be interrupted at any one or more of its links. And it may in fact be difficult to break one link without at the same time breaking others. This means that the cycle of high fertility, high mortality, and underdevelopment can be interrupted at the fertility link, i.e., by effective birth control, at the morbidity-mortality link by health measures (especially improvements in nutrition and infection control) or by social and economic development which significantly improves living standards. Logic dictates, however, that interrupting the cycle at several links simultaneously is more likely to be successful than trying to interrupt it at only one point at a time.

The complexity of the fertility-mortality cycle and the need to understand it in designing effective family planning programs are very well explained by Bajpai and his associates, writing about India:

> The two opposing biological factors in the country, i.e. high infant mortality and high birth rate, are interrelated in a complex manner. The vicious cycle of high fertility and high mortality can be broken by intelligent planning, by better methods of utilization of human and material resources, progress in public health programmes and better economic and social progress in the country. The family planning programmes in our country have to be reoriented and coordinated with measures to reduce foetal and neonatal loss so that ultimately there is a simultaneous fall in fertility rate and perinatal mortality.[7]

In industrialized countries the epidemiologic and demographic transitions, which have been accompanied by improved social and economic conditions, better health, and lower fertility, have resulted in the breaking of the cycle of high fertility and high mortality and the formation of a new cycle shown on the right side of the diagram in Figure 22.

THE PROFESSIONAL RATIONALE FOR THE HEALTH THEME

There can be no doubt that the medical profession has a great responsibility in the implementation of family planning programs. A brief summary of the organizational involvement and responsibilities of such medical professionals as clinicians, epidemiologists, medical biologists, nurses, midwives, health administrators, health educators, medical social workers, and biostatisticians, is given below. These responsibilities are reinforced by the strong ethical case for the health theme in family planning based on the relation between health and family planning variables which has been discussed in this monograph.

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[7] P. C. Bajpai *et al.*, "Observations on Perinatal Mortality," *Indian Pediatrics* 3 (1966): 96.

1. *Service:* Medical professionals — and it must be earnestly emphasized that this means *all* members of the health team mentioned above — are responsible for supporting family planning clinics and providing the services that require medical supervision, such as inserting intrauterine contraceptive devices; fitting diaphragms; performing abortions and sterilizations; choosing candidates for various regimens of oral contraceptives and treating side effects of this and other contraceptive measures, as necessary. Furthermore, medical personnel are in a position to take advantage of already existing health facilities to educate and motivate a target population in the use of contraception. For example, existing prenatal, postpartum, and child care clinics as well as other rural and mobile health units provide a ready channel for the dissemination of family planning information and materials.

The question arises in this context whether or not to integrate family planning services with health services. This is a challenging question, and there are convincing arguments on both sides. Wallace, Gold, and Dooley summarize them this way.[8] The advantages of integrating health and family planning services are both administrative and technical; administratively, integrated programs allow the sharing of funds, personnel, and facilities and thus avoid duplication of effort. Technically, "Integration of family planning and maternal and child health services is the way by which comprehensive maternal health care can best be provided for the individual woman," who can receive obstetric and gynecologic care as a continuum throughout her childbearing years — preconceptional, antepartum, postpartum, and interconceptional — rather than having to seek some services in one place and some in another.

The chief arguments in favor of separating family planning services from health services are that such separation gives family planning greater emphasis and visibility, and allows for its support and advancement at the highest government levels in countries which feel the need for population control as a matter of urgent national policy. Second, in countries which do not have well-developed maternal and child health services, it may not be possible to wait for their development before implementing full-blown and therefore, of necessity, separate family planning programs.

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[8] Helen M. Wallace, Edwin M. Gold, and Samuel Dooley, "Relationships Between Family Planning and Maternal and Child Health" (working paper, Human Reproduction Unit, World Health Organization, No. HR/Comp./69, II/B/3).

Whether or not to integrate health and family planning services is not a question to be easily or quickly answered; it is one which must be decided in each country — perhaps in each community — depending upon local conditions. The merits of the health theme as proposed here are equally relevant for separate family planning programs and for those integrated with other health services.

2. *Research:* Intensified research in reproductive physiology and contraceptive technology should aim at discovering the "ideal" contraceptive, or at least new contraceptive techniques that in comparison to those presently used, will be more effective and less harmful; will be easier to administer; will interfere less with sexual relations; will require a minimum of motivation; and preferably will not require a physician for application or prescription. The possible effects of prolonged use of hormones, intrauterine devices, and proposed immunologic techniques for contraception need to be examined and methods of control devised. Research in health care delivery systems can be conducted to great advantage in family planning programs and can include experimentation with alternative approaches to family planning that utilize health motivation systems and integrate both health and contraceptive services.

THE CULTURAL RATIONALE FOR THE HEALTH THEME

That the cultural parameters affecting health and fertility are subtle and complex can be readily perceived by skimming any of a number of books and articles on these subjects. Two examples are Frank Lorimer's *Culture and Human Fertility*[9] and the section on health in *Cultural Patterns and Technical Change.*[10] The need to understand thoroughly and to take into account the prevalent cultural feelings in either or both of these areas in attempting to establish new health or family planning programs cannot be too strongly emphasized. Yet despite the need for custom-tailored health and family planning programs for each geographical area and cultural group, the rationale for the health theme as a buttress of family planning in almost any culture is straightforward and the prospects for its usefulness are good.

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[9] Frank Lorimer, *Culture and Human Fertility* (Zurich: United Nations Educational, Scientific and Cultural Organization, 1954).

[10] World Federation for Mental Health, Margaret Mead, ed., *Cultural Patterns and Technical Change* (New York: The New American Library of World Literature, 1962), pp. 217-36.

The rationale is simply this: although there are as many definitions of good health as there are cultures in the world, good health is almost universally prized. Therefore, showing that family planning is essential to the achievement of good individual, family, and national health can be a strong support for family planning programs.

The health theme has the further considerable advantages of being a personal, positive impetus to family planning, of bypassing many political objections to birth control, and of giving direct or indirect support to other themes in birth control programs. The health theme provides the positive motivation for family planning of good health in an immediate, personal way, as opposed to such more or less remote motivations as curtailing fertility for political or economic reasons, which many individuals might not feel to be applicable to themselves. In situations where two religious, social, cultural, or national groups are in conflict, any attempt to institute family planning is often regarded as an attempt by one group to weaken or wipe out the other. Once it is recognized that family planning is in fact essential to good health, and thus to individual and group strength, this objection can be overcome, and the health theme may thus, in fact, support the nationalistic theme in birth control.

APPENDIX

PATHOLOGICAL TOGETHERNESS: THE ANIMAL EVIDENCE

This appendix provides a brief review of the literature which deals with the reactions of various animal species to high population density. Since animals can be subjected to much more rigorous experimental conditions than can humans, the most convincing evidence that health and behavior are adversely affected by high population density comes from animal studies. This evidence cannot, of course, be extrapolated to human populations, but it is impossible to ignore the similarities to some of the evidence presented in the early chapters of this monograph on the association in human groups between high population density and such factors as poverty, poor physical and mental health, and high infant mortality. Just as pharmacological studies in animals can help to pinpoint potential hazards for humans, it may be that animal reactions to crowding may indicate areas for man's careful scrutiny.

Carefully controlled laboratory experiments with various animal species indicate that each population has an upper asymptote of growth and that no population can grow beyond this level without corrective population-controlling mechanisms of one kind or another coming into play. It is important to note, however, that the "carrying capacity" of the habitat may be defined in terms of social relationships as well as in terms of physical resources; that is, intolerable population density or crowding cannot be quantified simply on the basis of the number of animals per unit of space; rather, crowding is a relative concept denoting any change in a population which results in increased social or biological competition. For example, "crowded" conditions may result from intensified competition for food or some other tangible resource; in other cases, particularly among gregarious species, increases in social interaction (even if among only a few animals) seem to distract the animals and ultimately disrupt normal feeding and sleeping habits. Restrictions on mobility and infringements on an organism's "critical distance" — the area around him into which no other organism can intrude without his feeling threatened — may also produce the physiological and behavioral reactions associated with crowding.[1]

Various mechanisms are operative in the regulation of animal population growth; normally, these mechanisms maintain a dynamic equilibrium between an animal population and its habitat by producing moderate demographic changes. As the population nears the carrying capacity of the environment, however, the corrective mechanisms will operate with increasing violence to bring the population size under control and may even produce extreme symptoms of physical or behavioral disorder in the process.

Changing densities of animal populations are manifested by cyclic patterns of population change. The length and the periodicity of fluctuations in population size vary as a function of an organism's ability to adapt to changing environmental conditions, changing population density, or both. Even when food, predation, and other environmental variables are held constant by experimental design, population cycles are evident; thus, the controlling mechanisms of cyclic change in contained environments seem to be density-dependent — that is, density is the essential determinant of the changes in mortality and/or fertility which are reflected by the fluctuating curve.

Before we turn to a review of laboratory and field studies on the operation of density-dependent factors in animal populations, two points deserve mention: (1) Stability of growth patterns is essential for species survival; as Davis points out, "Populations with enormous fluctuations . . . are in danger of local and eventually total extinction. . . . Damping of oscillations occurs in populations of higher animals, including insects and vertebrates, and decreases the likelihood of local extinction."[2] (2) Stability tends to vary directly with the multiplicity of adaptive, self-regulatory mechanisms which characterize the physiological and behavioral capacities for adjustment for any given species. Negative feedback mechanisms trigger self-regulation and are of tremendous survival value for a species. They prevent "overexploitation of habitat . . . wastage of young and increase the efficiency of utilization of the resources. At highest efficiency every unit of energy eventually becomes part of a breeding adult."[3]

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[1] For a discussion of such topics as "critical distance" and crowding in animals and man, see Edward T. Hall, *The Hidden Dimension* (Garden City, New York: Doubleday and Co., 1966).

[2] David E. Davis, *Integral Animal Behavior* (New York: The Macmillan Company, 1966), pp. 101-02.

[3] *Ibid.*, p. 108.

PHYSIOLOGICAL REACTIONS TO CROWDING

Among a great variety of animals, fertility, mortality, morbidity, rate of maturation, and endocrine activity have all been shown to be sensitive to crowding. Among lower forms of animals, the mechanisms of population control have been shown to work through fertility and mortality very directly. For example, of the sheep blow fly, for which there are differences in food requirements for various stages of metamorphosis, Nicholson concluded that the survival of larvae competing for a limited amount of food was the crucial regulator of population. The number of adult flies showed little association with the adult food supply but rather depended on the number of larvae which successfully pupated. When the adult population was large, many eggs were laid; the intensity of maggot (larva) competition for a limited supply of meat increased accordingly, with the consequence that food supply was often exhausted before any of the larvae attained the size required for successful pupation. The failure of the larvae to pupate diminished the adult population to the point that fewer adults were available to lay eggs; the few eggs resulted in less competition among larvae for food, thus more of them pupated until the adult population grew so large that enough eggs were laid to exhaust the food supply and begin the cycle again.[4]

Many studies among higher animals have shown that fertility can be altered by crowding. Errington reported a decrease in the number of muskrat broods from four per season to one or two under crowded conditions.[5] Decrease in the *size* of the litters of microtines (voles, lemmings, muskrats) in response to crowding has also been reported, by Patric in 1962 and Krebs in 1963.[6]

In his review article, "The Pathology of Overpopulation," Christian cites his own experiments and those of others which indicate that the reduction in fertility under crowded conditions could be attributed to inhibition of maturation in both males and females, to increased abortion, and to resorption of embryos.[7] In some instances of maturation inhibition in mice, the reproductive capacity may never develop in females;[8] in other cases, for both males and females the development of secondary sex characteristics is delayed,[9] and in males, the seminiferous tubules may be small and spermatogenesis may be abnormal.[10]

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[4] A. J. Nicholson, "The Self-Adjustment of Population to Change," in *Population Studies: Animal Ecology and Demography, Cold Spring Harbor Symposium in Quantitative Biology* 22 (1957): 153-72, cited in Brenda Sladen, "Experimental Demography with Laboratory Invertebrates," in Brenda Sladen and Frederik Bang, eds., *Biology of Populations* (New York: American Elsevier Publishing Co., 1969), pp. 75-78.

[5] Paul L. Errington, "Factors Limiting Higher Vertebrate Populations," *Science* *124* (1956): 304-7.

[6] E. F. Patric, *J. Mammal 43* (1962): 200 and C. J. Krebs, *Science 140* (1963): 674, cited in John J. Christian, James A. Lloyd, and David E. Davis, "The Role of Endocrines in the Self-Regulation of Mammalian Populations," *Recent Progress in Hormone Research 21* (1965): 501-78.

Other biological controls on animal population growth, besides decreased fertility, are increased morbidity and mortality. Under crowded conditions, resistance to infection decreases to some extent and there is an increase in the prevalence of certain diseases, such as Alloxan diabetes in rats[11] and a reactivation of latent rabies in guinea pigs.[12]

Increased mortality has been shown to take a great toll among the embryos and infants of mice, voles, and rabbits;[13] the increase was ascribed not only to biologic reasons such as a failure in lactation triggered by maternal hormonal reactions to crowding, but also to neglect of infants. There is also a relative increase in maternal mortality and difficult labor under crowded conditions.[14]

Only under very severe conditions of crowding is the mortality of adults significantly affected. One such case was that of the Sika deer on Jamestown Island, Maryland. Several deer had been taken to the island in 1916 and, breeding freely, had reached a population of 280 to 300 in 1955 when Christian began an investigation of the population. He observed no significant changes in the population until 1958 when over half the deer suddenly died. Histological examination of deer dying between 1955 and 1960 (by which time the population had stabilized around 80) indicated no significant change in adrenal weights between 1955 and 1958; a decrease in adrenal weight of 46 percent and 81 percent for mature and immature deer, respectively, after 1958 was interpreted as indicating a drastic reduction in crowding-induced stress after the die-off. As to the die-off itself, Christian said, "Mortality evidently resulted from shock following severe metabolic disturbance, probably as a result of prolonged adrenocortical hyperactivity, judging from the histological material. There was no evidence of infection, starvation, or other obvious cause to explain the mass mortality."[15]

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[7] John J. Christian, "The Pathology of Overpopulation," *Military Medicine 128* (1963): 571-603.

[8] P. Crowcroft and F. P. Rowe, *Proc. Zool. Soc. London 129* (1957): 359, cited in Christian, Lloyd, and Davis, p. 512.

[9] John J. Christian, *Proc. Natl. Acad. Sci. U. S. 47* (1961): 428, cited in Christian, Lloyd, and Davis, p. 513.

[10] John J. Christian, *Ecology 37* (1956): 258, cited in Christian, Lloyd, and Davis, p. 512.

[11] Robert Ader, Albert Kreutner, Jr., and Harry L. Jacobs, "Social Environment, Emotionality, and Alloxan Diabetes in the Rat," *Psychosomatic Medicine 25* (1963): 60-68.

[12] O. A. Soave, *Am. J. Vet. Res. 25* (1964): 104, cited in Christian, Lloyd, and Davis, p. 511.

[13] Christian, Lloyd, and Davis, pp. 512-19.

[14] *Ibid.*, and John B. Calhoun, "Population Density and Social Pathology," *Scientific American 206* (1962): 139-48.

BEHAVIORAL RESPONSES TO CROWDING

Among some of the lower animals, behavioral responses to crowding are quite predictable and often immediately corrective. Cannibalism appears to be a "normal" approach to population control in several species, and may or may not be related to the availability of food or space. The flour beetle, for example, practices cannibalism of the defenseless stages (egg and pupa) in direct proportion to the *number of contacts* between the feeding and fed-upon individuals.[16] In some animals, the corrective behavioral response to crowding may operate to reduce reproduction rather than to increase mortality. In one species of Japanese fish, which only breeds when in possession of its own territory, Miyadi observed that with rising population, more and more fish relinquished territory; whenever the population became very dense, all the fish ceased breeding and became a school.[17]

Among the so-called "social" insects (such as termites, wasps, bees, and ants), self-adjustment of numbers is always occurring. The queen is the only fertile female and regulates her oviposition according to food supply and population density in the colony; all the other females, as well as some of the males, form subordinate castes. Under conditions of crowding, population balance may be restored by egg-eating, fratricide, or expulsion of subordinate or marginal members of the colony.[18]

Subordination is a common feature of social organization in animal populations; often, it appears to be adaptive, as in the case of the social insects, or even essential for allocating scarce resources and regulating population growth. In nearly all cases, its effects add up to forced dispersal of subordinate animals to marginal areas of the habitat where

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[15] Quoted in Hall, *The Hidden Dimension*, p. 19.

[16] T. Park, "Experimental Competition in Beetles, with Some General Implications," in J. B. Cragg and N. W. Pirie, *The Numbers of Man and Animals* (London: Oliver and Boyd, 1955), cited in Lawrence B. Slobodkin, *Growth and Regulation of Animal Populations* (New York: Holt, Rinehart and Winston, 1966), pp. 96-97.

[17] D. Miyadi, "Perspectives of Experimental Research on Social Interference Among Fishes," in A. A. Buzzati-Traverso, ed., *Perspectives in Marine Biology*, cited in Frederik Bang, "Introduction to Behavior Studies," in Sladen and Bang, pp. 243-44.

[18] D. G. Harcourt and E. J. Leroux, "Population Regulation in Insects and Man," *American Scientist* 55 (1967): 400-15.

survival and reproduction rates are assuredly lowered. Restricted mobility, persistent threats, and effective ostracism characterize subordinates who may have neither territory (suitable breeding and feeding sites) nor social status or rank. The number of subordinate animals in a population tends to rise as density increases. Sometimes, moderate levels of subordination are instrumental in reducing numbers and alleviating population pressure; if, however, this method of what Wynne-Edwards calls "conventionalized rivalry" fails, crowding and conflict may intensify to the point that social organization gives way to despotism or anarchy.[19] Deviations from conventionalized behavioral responses may become rampant as progressively larger segments of the population become involved in fighting, disruptive aggression, catatonic withdrawal, aberrations in sexual and maternal behavior, and syndromes of stress and physiological breakdown. The gamut of moderate and extreme responses to crowding which has been observed in various animal groups is illustrated below.

Brown conducted a long-term study of bioenergetics in confined house mice and reported that at low population density, the major energy expenditure involved reproductive behavior and care of offspring. As the population increased, however, more and more energy was spent in "agonistic" behavior (threats, attacks, fights, submissions) and proportionally less for maternal care and reproduction until population growth eventually ceased.[20]

Among the forms of behavior apparently aimed at controlling population is migration. In the famous case of Scandinavian lemmings, it has been concluded that physiological mechanisms triggered by a stress syndrome response to density caused reactions which led to unidirectional movement in constant compass direction away from the natural habitat, and in some cases into arctic waters. The resultant drownings offer a clear example of pathological behavior: all who exhibit it die.[21] Migration is generally selective in that subordinate members of an animal group are the ones who migrate to the boundaries of the population and hence are at high risk of predation. In this regard, Errington states that "insecurity of position can impose as deadly a handicap on an animal in normal physical condition as can the sluggishness or weakness of an animal that is physically subnormal."[22]

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[19] V. C. Wynne-Edwards, *Animal Dispersion in Relation to Social Behavior* (New York: Hafner, 1962) and "Self-Regulating Systems in Populations of Animals," *Science 147* (1965): 1543-48.

[20] R. A. Brown, "Bioenergetics of House Mouse Populations" (unpublished manuscript, 1967), cited in Charles H. Southwick, "Population Dynamics and Social Behavior of Domestic Rodents," in Sladen and Bang, p. 292.

[21] John B. Calhoun, "Ecological Factors in the Development of Behavioral Anomalies," in Joseph Zubin and Howard F. Hunt, eds., *Comparative Psychopathology: Animal and Human* (New York: Grune and Stratton, 1967), pp. 2-4.

The natural self-regulation of rabbits in an 18-acre wire enclosure was studied by Mykytowycz for four years. Both ranking and territoriality distinguished the dominant individuals, who consistently demonstrated better health, higher survival of both adults and young, little intrauterine loss, highly successful fertility performance, and much higher resistance to a myxomatosis epizooic which killed nearly all of the rabbits without territory in the second year of the study. During a food shortage the following year, all the young died as well as 58 percent of the adults; the dominant males had the highest survival rate (77 percent). Over the four years the population fluctuated greatly; the authors observed that the population declines were directly caused by decreased fertility, increased mortality among the young, and that both of these rates varied according to the status of the mother.[23]

The studies of rats by Calhoun are classics in the literature on population density and social pathology. Calhoun studied rats under conditions in which the animals were protected from outside predation, from starvation, and other external threats; thus, "only the animals' behavior with respect to one another remained as a factor that might affect the increase in their number."[24] In various experiments, Calhoun noted such results of the stress of crowding as increased fighting, homosexuality, and neglect of the usual courtship rituals by males; a few dominant males eventually became the sole reproducers in some of the experimental populations. Among the females and infants there were a number of indicators of stress: high rates of abortion, infant mortality, and maternal mortality. Females often failed to build nests and often did not care for or nurse their young; as a result, the young were often scattered about and eaten. Calhoun called these phenomena, "pathological togetherness."

The social disruption was most dramatic in those experiments in which a "behavioral sink" developed; under these conditions, "Eating and other biological activities were . . . transformed into social activities in which the principal satisfaction was interaction with other rats. In the case of eating, this transformation of behavior did not keep the animals from securing adequate nutrition. But the same pathological 'togetherness' tended to disrupt the ordered sequences of activity involved in other vital modes of behavior such as the courting of sex partners, the building of nests and the nursing and care of the young."[25] Infant mortality can be taken as a measure of the degree of disruption in the crowded colonies; in those where no behavioral sink developed, infant mortality reached about 80 percent, and in the "behavioral sink" colonies, as much as 96 percent among the most disoriented groups of animals.

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[22] Errington, p. 307.

[23] R. Mykytowycz, "Social Behavior of an Experimental Colony of Wild Rabbits, *Oryctolagus cuniculus* (L.)," C.S.I.R.O., *Wildlife Research* 5 (1960): 1-20 and 6 (1961): 142-55 and "Territoriality in Rabbit Populations," *Australian Nat. Hist.* 14 (1964): 326-29, cited in William J. L. Sladen, "Social Organization in Some Birds and Mammals," in Sladen and Bang, pp. 274-77.

[24] Calhoun (1962), p. 139.

BEHAVIORAL-PHYSIOLOGICAL INTERACTIONS IN RESPONSE TO CROWDING

Although the dichotomy between physiological and behavioral responses to crowding has provided a useful division for our purposes in summarizing mechanisms of population control in animals, recent research has begun to make clear that there is in fact a fascinating and complex feedback system in which both behavioral and physiological factors are affected and to which endocrine changes may be the key. The complex hormonal mechanism, the details of which are beyond the scope of these brief notes, can be outlined as follows: A variety of stress situations — some of these the result of crowding — can activate the hypothalamus which in turn stimulates the pituitary gland to release hormones which affect various other organs in the body.[26]

One of the most extensively studied of these hormones is adrenocorticotropin (ACTH) which can affect the gonads, and consequently, reproductive capacity. One effect of ACTH is to inhibit sexual development, and to interfere with pregnancy and lactation. Reproduction is affected indirectly and mortality directly by another effect of ACTH which leads to an increase in morbidity; this is interference with the metabolism of proteins, which results in decreased resistance to infections. This lowering of resistance is a result of changes in inflammatory processes and reduction of immunologic resistance.

Information is less complete on hormonal effects on reproductive *behavior* (as opposed to reproductive capacity), but there are indications that changes in the amounts of the male hormone testosterone or the female hormone estrogen as a result of crowding stresses may alter courtship behavior, thus indirectly affecting fertility. Survival chances of newborns may also be affected by alterations in maternal behavior as a result of hormonal changes.

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[25] *Ibid.*

[26] For a brief explanation of endocrine feedback, see Davis, pp. 80-93; for a more comprehensive review of endocrine studies, see Christian, Lloyd, and Davis.

Animal studies indicate that complex feedback mechanisms involving dynamic interactions between social and physiological processes can be triggered by population pressures, and these results suggest exciting avenues for further research on human populations. In a provocative article on the health consequences of population density, Cassel points out that no human studies have been conducted to determine whether or not man may be subject to changes in endocrine secretions as a result of the stresses of high population density. Since an understanding of the mechanisms through which crowding affects human health is essential to coping with the problems of population pressure and disease, it is imperative that such studies should be carried out. In formulating the research questions for such studies, Cassel stresses that it is important to recognize "that increased population density increases the importance of the social environment as a determinant of physiological response to various stimuli, including potentially disease-producing agents; that within this social environment the quality of social interactions and position within the group seem to be important factors; and that given time, adaptation to these social changes can and does occur, but the newcomers to the situation will always be the segment of the population at highest risk."[27]

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[27] John Cassel, "Health Consequences of Population Density and Crowding," in National Academy of Sciences, *Rapid Population Growth: Consequences and Policy Implications* (Baltimore: Johns Hopkins Press, 1971), pp. 462-78.

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